

APRIL  
1953

# Chemical Engineering



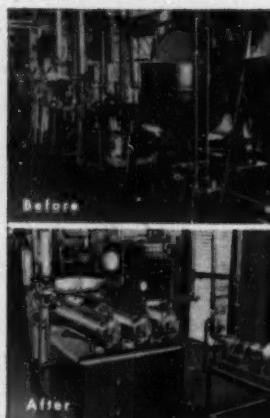
◀ New tricks to heat  
exchanger design.

• What makes a good  
vibrator set-up?

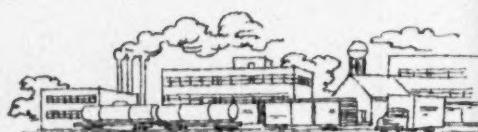
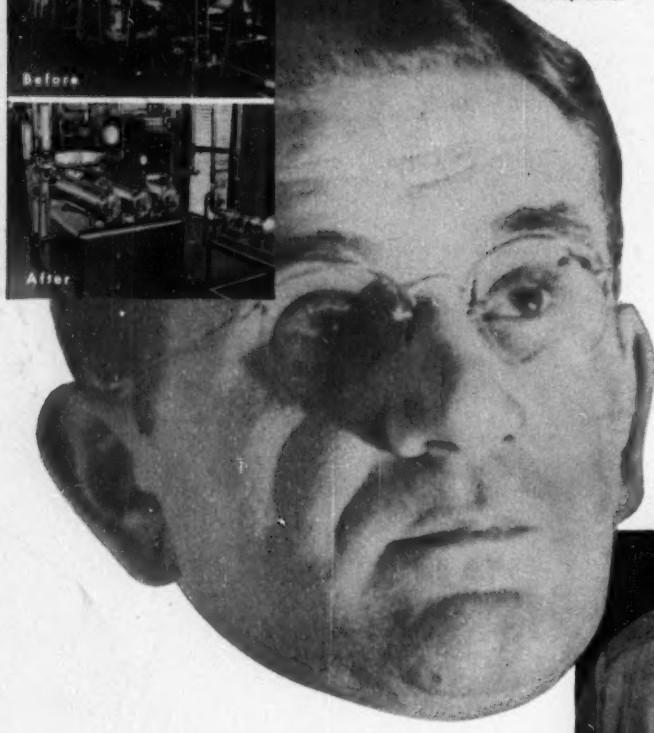
• Use statistics to  
speed up your work.

• How to simplify  
your cost estimates.

• Evaporation: methods,  
problems, equipment.



**BEFORE... AND AFTER.** Jelly candy is now produced continuously at the Charms Company—with one VOTATOR Heat-transfer unit replacing open kettles. The process was developed with the technical assistance of Charms and National Research Products Inc., a company with wide experience in research developments.



## Continuous processing know-how... by Girdler

Continuous processing of food or chemical products is the key to production efficiency. It assures a uniform product, and improves quality control. It eliminates product handling and reduces labor and floor space requirements.

Girdler has developed continuous processes for a wide variety of products . . . and offers unit responsibility for design and construction of processing facilities. If you process liquid or viscous materials—from axle grease to baby food—you can use Girdler's experience to your advantage. Call the nearby Girdler office today.

The **GIRDLER** Corporation

LOUISVILLE 1, KENTUCKY

**VOTATOR DIVISION:** New York, Atlanta, Chicago, San Francisco

**GAS PROCESSES DIVISION:** New York, Tulsa, San Francisco

In Canada: Girdler Corporation of Canada Limited, Toronto

# THIS IS GIRDLER

**GIRDLER DESIGNS** processes and plants

**GIRDLER BUILDS** processing plants

**GIRDLER MANUFACTURES** processing apparatus

### **VOTATOR DIVISION:**

Complete Edible Oil Plants

Continuous Processing Apparatus for . . .

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Margarine	Citrus Concentrates	Paraffin Wax
Lard	Chemicals	Resins
	Paper Coating	And other Products

### **GAS PROCESSES DIVISION:**

Chemical Processing Plants

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Hydrogen Production Plants

Acetylene Plants

Hydrogen Cyanide Plants

Ammonium Nitrate Plants

Synthesis Gas Plants

Hydrogen Chloride Plants

Carbon Dioxide Plants

Catalysts and Activated

Gas Purification Plants

Carbon

Foundry Core Baking

Plastics Materials Plants

### **THERMEX DIVISION:**

High Frequency Dielectric Heating  
Equipment Applied to . . .

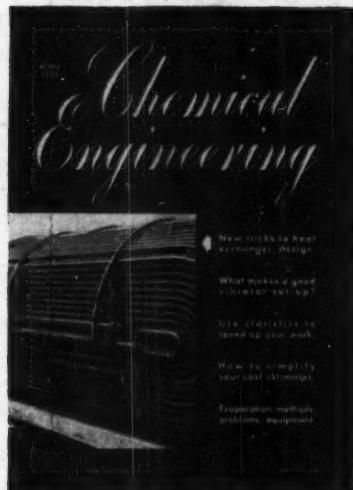
Rubber Drying and Curing

Wood Bonding

Plastic Preform Preheating

## GUIDED TOUR

JOHN R. CALLAHAM, EDITOR



### Heat Technology

Once every year we go all-out to prepare a special issue on some unit operation or engineering subject of broad and basic interest.

Last year it was Process Instrumentation in May; this year it'll be Heat Technology in June.

Our Heat Technology report will pretty well cover the subject—the production, containment, transport and transfer of heat and cold over the entire range of industrially used temperatures. Purpose of the report is to give the engineer an over-all survey of all the basic methods he can use to solve any process problem that involves heat or cold.

One unique feature will be a folded chart in color to show the industrial "thermal spectrum" and how it fits into chemical processing methods. This chart, we believe, will prove to be every bit as popular as last May's "Elements of Process Instrumentation."

Watch for our June issue and its special 48-page report.

### ..... New tricks to heat exchanger design.

This time Author Gilmour spills his bag of tricks on how to design a heat exchanger when one fluid undergoes a change in phase—such as in heaters and condensers. Use his shortcuts and you can do it in half the time it takes by the usual methods, he says (*Feature Article*).

### Next time try out statistics.

You'll be surprised how often they can speed up your everyday work—and make it more accurate, too. In this article (first of a series) Authors Ferencz and Lloyd give proof of the pudding with more than a dozen down-to-earth examples (*Feature Article*).

### Simplify your cost estimates.

How? Just by using the proper nomographs. Here's how you can show a complete economic picture without having to use reams of graphs and tables (*Feature Article*).

Please turn page

**GUIDED TOUR**



**The low-down on evaporation.**

Yes, here it is. Author Lindsey's report covers the newer as well as standard types of evaporators. It reviews energy-saving methods, defines the most common evaporation problems—then points out what you can do about them (*Feature Report*).



**New process for acrylics.**

Here is how Rohm & Haas now makes acrylic monomers directly from acetylene and carbon monoxide. It's a lot cheaper, they say, than the older ethylene-base process. (*What's Happening . . .*).



**Tower uses kinetic energy.**

Result: A fast-moving, horizontal, vapor-liquid mixing action across the contact plate surface. Fast startup, high throughput, no dead zones. It's the new Kittel contact plate and here are the details (*Process Equipment News*).



**Rejoin GUIDED TOUR page 281**

APRIL  
1953

# Chemical Engineering

CHEMMENTATOR ..... 105

**WHAT'S HAPPENING IN CHEMICAL ENGINEERING**

New Process for Acrylics.....	114
How's Industrial Research?.....	116
Dow Cleans Its Own Tank Cars.....	118
Bacteria by the Bagful.....	120
From Pollution to Profit.....	122
Giant Pots Feature Integrated Al Plant.....	128
Liquid O <sub>2</sub> Unit Travels by Air.....	138

PRO AND CON ..... 156

**FEATURE ARTICLES**

Electrolytic Process With Promise.....	189
<i>Erich Konrad</i>	
Simplify Your Cost Estimates.....	193
<i>L. Lynn and J. R. McKieveen</i>	
What's Chemical Engineering's Outstanding Achievement? .....	196
How to Plan Power Distribution.....	199
<i>W. B. Wilson</i>	
What Makes a Good Vibrator Set-up?.....	204
<i>Frederick Marich</i>	
Shortcut to Heat Exchanger Design—III.....	214
<i>C. H. Gilmour</i>	
Next Time, Use Statistics.....	219
<i>P. Ferencz and B. H. Lloyd</i>	
Design of Cooler Condensers for Vapor-Gas Mixtures—I .....	223
<i>G. H. Bras</i>	

EDITORIAL VIEWPOINTS .....	208
PLANT NOTEBOOK	
<b>Paper Diaphragm Starts Siphon for Corrosive</b>	
Liquids .....	210
<i>Renzo Volterra</i>	
FEATURE REPORT	
<b>Evaporation .....</b>	<b>227</b>
<i>E. E. Lindley</i>	
PROCESS EQUIPMENT NEWS	
<b>Tower Utilizes Kinetic Energy.....</b>	<b>242</b>
<b>Flow Rate Controls Pumping.....</b>	<b>246</b>
<b>Process Analyzers Use Infrared.....</b>	<b>258</b>
PRODUCT NEWS	
<b>Maybe Tires Will Outwear Autos.....</b>	<b>262</b>
PICTURED FLOWSHEET	
<b>High Purity Liquid SO<sub>2</sub>.....</b>	<b>274</b>
YOU AND YOUR JOB	
<b>How Good a Technical Witness Are You?.....</b>	<b>282</b>
CORROSION FORUM	
<b>Stainless Steels .....</b>	<b>290</b>
QUOTES, EXTRACTS AND DIGESTS	
<b>Common-Sense Corrosion Control.....</b>	<b>332</b>
CHEMICAL ECONOMICS	
<b>Plastics on the Move .....</b>	<b>370</b>
TOMORROW'S TECHNOLOGY	
<b>New Feeder for Loose Solids.....</b>	<b>374</b>
<b>Stronger Gypsum Plaster.....</b>	<b>380</b>
<b>Your Checklist of New Patents.....</b>	<b>390</b>
OTHER DEPARTMENTS	
<b>Book Reviews .....</b>	<b>356</b>
<b>Convention Calendar .....</b>	<b>127</b>
<b>Industrial Notes .....</b>	<b>322</b>
<b>Industry Trends .....</b>	<b>372</b>
<b>Names in the News.....</b>	<b>308</b>
<b>New Technical Literature.....</b>	<b>362</b>
<b>Recent Pamphlets .....</b>	<b>358</b>
<b>Reader Service Section .....</b>	<b>477</b>



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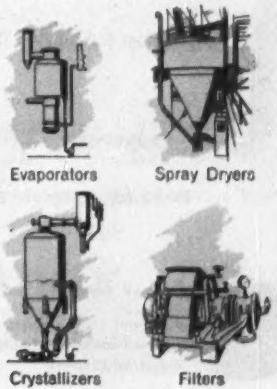
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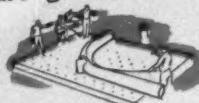




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Grinnell finances material inventories and payrolls; carries insurance.

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It is cleaned inside and outside and painted. Squared to standard dimensional tolerances, sub-assemblies are erected



at the job site more quickly and easily. It all adds up to this . . .



shop fabrication by Grinnell guarantees quality and economy.

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**WHENEVER PIPING IS INVOLVED**

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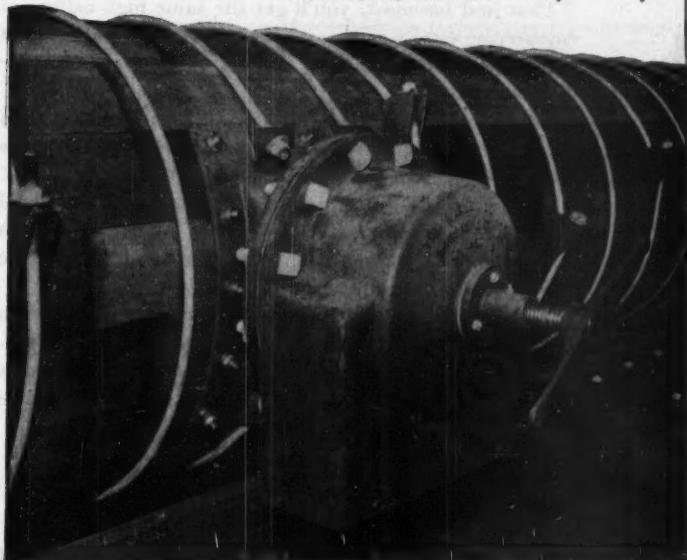
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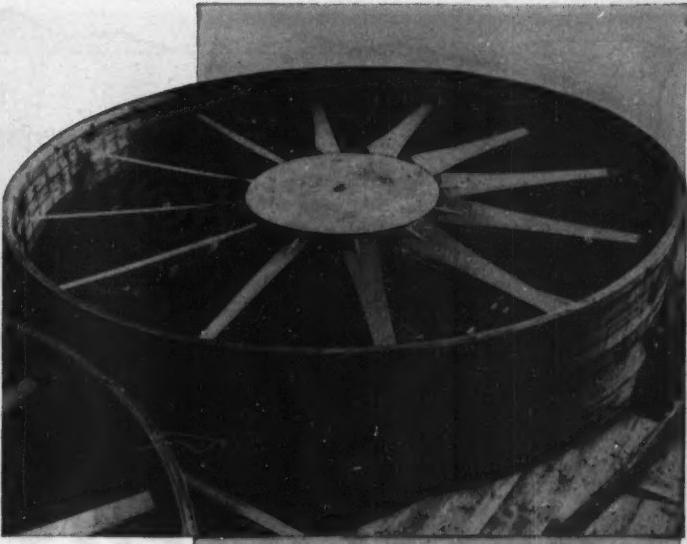


\*Any cooling tower can be modernized with Marley design features.



## The Marley Company

Kansas City, Missouri



#### **Marley Multi-Blade Fans —**

These fans are aerodynamically correct in design to move air in volume efficiently. Their further accomplishment is to remove pulsation with its damaging vibration.

#### **Marley Patented Laminated Fan Cylinders —**

Built of multiple plies of redwood, the Laminated Fan Cylinder is completely non-corrosive and vibration resistant. Field service proves its permanence.

#### **Marley Redwood Pipe —**

This header pipe is carefully prefabricated in Marley's wood fabrication plant for cooling towers (largest in the world). Its perfect fit and strong, adjustable steel bands on close centers assure its long life. On the job it is erected easily, quickly.

#### **Marley Flow Control Valve —**

Marley flow control valves insure equal distribution of water to each cell and effectively handle any quantity of water from full basin capacity to complete shutdown.

Ask your Marley Sales Engineer (in fifty cities) for detailed information about these achievements that have maintained Marley leadership.

**A message of special significance  
to filter users everywhere**

Effective January 1, Niagara Filter Corporation became a part of American Machine and Metals, Inc.

Production will be transferred gradually from the present Niagara Filter plant at Buffalo, N. Y., to the 83-acre AM&M plant at East Moline, Illinois. Engineering, sales and service head-

quarters will remain at the Buffalo address until further notice.

Niagara engineering, sales and service policies remain unchanged. Service to present Niagara customers, and new customers, will of course be maintained without interruption.

**Why you'll get**

# **BETTER FILTRATION**

**now that NIAGARA FILTER is a division of  
AMERICAN MACHINE and METALS, INC.**

You have a large "plus" to gain from the new Niagara Filter administrative and manufacturing set-up.

First and foremost, you'll get the same high calibre of engineering service as always; the same unique background of experience in filtration, applied to your specific production needs.

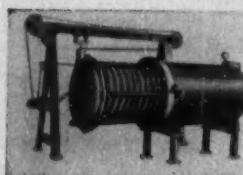
Second, your new Niagara Filter will be better built than ever before. Niagara engineers and production men are now working with vastly improved manufacturing tools. They are already drawing upon the resources and skills of the AM&M production staff—backed by large, modern plant facilities that greatly simplify the job of building the right filter for your operations.

Third, you'll get faster service. Your order will get into production days, even weeks earlier than heretofore possible. You'll enjoy, that much sooner, the unusual labor and upkeep savings which Niagara Filters make possible in processing plants everywhere.

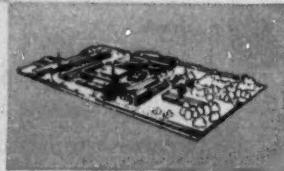
**VERTICAL**—for liquid clarification.



**HORIZONTAL**—for clarification and solids recovery.



**NEW HOME** of Niagara Filters will be this modern 83-acre AM&M plant on the Mississippi River at East Moline, Illinois.



**Niagara Filter** DIVISION

**AMERICAN MACHINE and METALS, INC.**

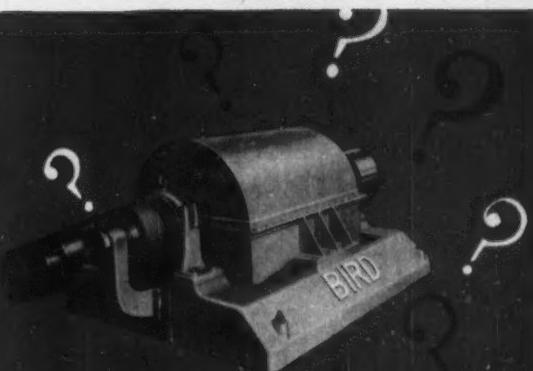
**SALES AND ENGINEERING OFFICE:  
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(Please address correspondence to above address)

**FACTORY: East Moline, Illinois**

April 1953—CHEMICAL ENGINEERING

# WHAT DO YOU WANT IN A FILTER?



## HIGH CAPACITY



A small size (18" x 28") Bird Continuous Centrifugal Filter washes and dewater salt crystals from an organic solution. It delivers tons of salt per hour with only 3% moisture content. 99% plus of the organic material is recovered, using only 0.2 lbs. of wash water per lb. of salt.

## LOW MAINTENANCE



A Bird Filter used on heavy duty war service on chemicals for explosives has kept right on producing for mining industry needs. In ten years of steady operation the Bird has only been dismantled once and that only for a check up.

## THOROUGH SEPARATION



One small Bird Filter handles 28,000 lbs., dry weight per day of an important agricultural chemical. Feed consistency is 32% solids. Temperature, 25°C. Solids discharge contains less than 5% solvent. Filtrate is essentially clear.

## CONTINUOUSLY DEPENDABLE OPERATION

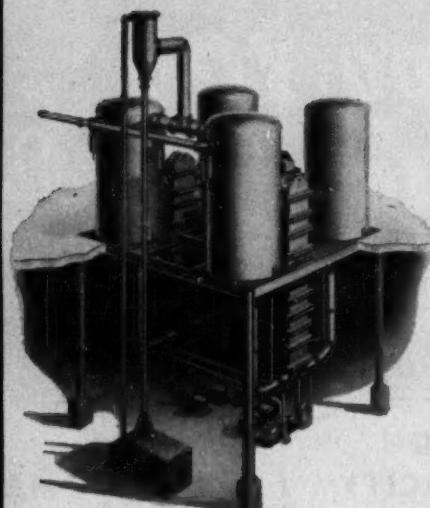


You put BIRDS in and they run and keep on running. Thirty-three Birds are now on the job for this one company on eight different materials. The first were put in ten years ago. Since then there have been eleven repeat orders.

Why not find out what the Bird Centrifugal Filter can do for you? *The Bird Research and Development Center* is ready to provide pilot scale test data in advance of your equipment investment. Findings will be unbiased because Bird builds all types—*Continuous Centrifugal Filters and Classifiers, Continuous Vacuum Filters, Batch Centrifugals*.

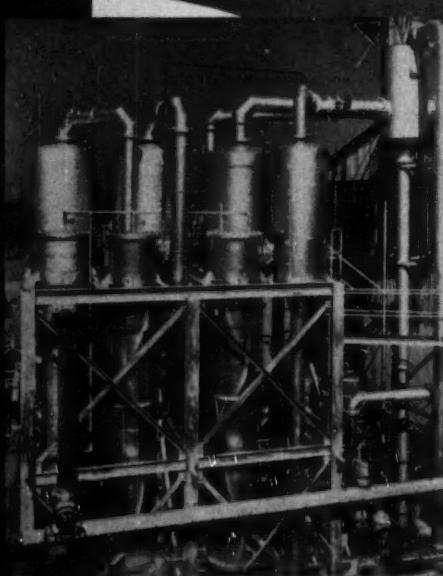
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process  
equipment  
built to  
fit your  
needs



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Switching System permits  
continuous operation at  
full capacity. A periodic  
condensate wash of *all*  
parts removes chemical  
scale.

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Conkey Long Tube Film Type  
Evaporator concentrates foaming  
liquids and heat-sensitive  
materials. Operates efficiently  
at extremely low temperature  
differentials.



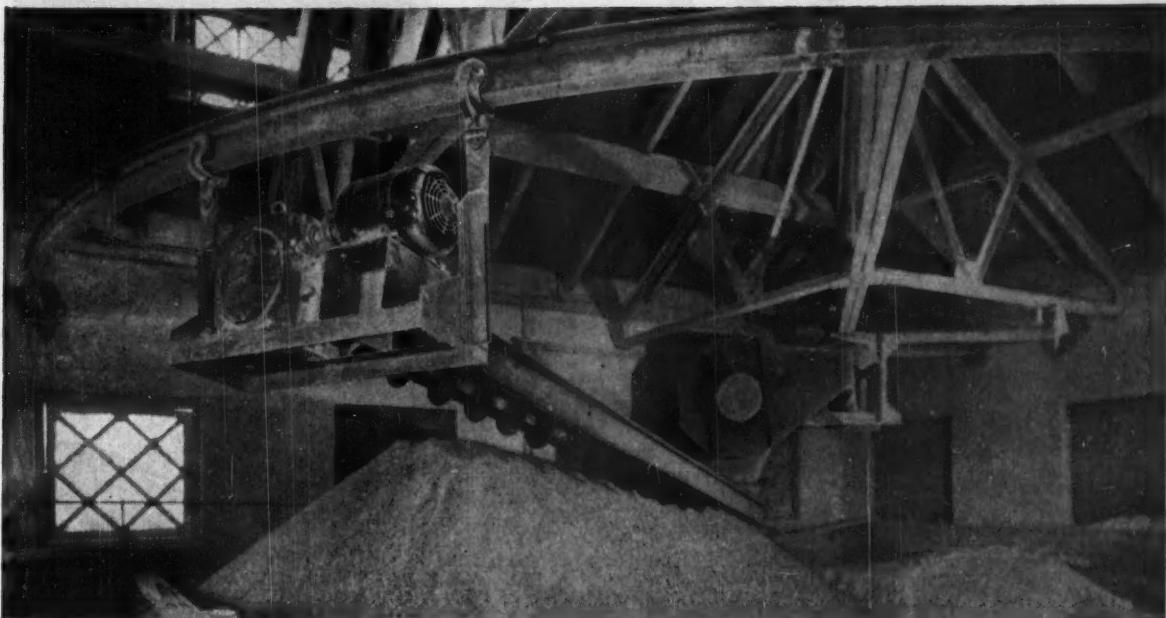
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Chemical storage system using rotating Link-Belt screw conveyor, 19-ft. radius, with outer end suspended by trolleys from curved track. Link-Belt Bulk-Flo conveyor-elevators carry material from railroad track hoppers to hopper above pivot point of screw conveyor.

## There's no substitute for "total engineering" in screw conveyors

**LINK-BELT integrates all components to give you the right screw conveyor for your job**

HERE'S how "total engineering" works for you when you buy Link-Belt Screw Conveyors.

First, conveying specialists analyze your problem. Then, Link-Belt's vast experience in design and manufacture is at your command to recommend the

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Link-Belt "total engineering" on your screw conveyors is your assurance of efficient design . . . balanced performance.

To benefit from Link-Belt's materials handling experience and engineering service, contact the Link-Belt office near you.

### LINK-BELT designs and builds all components



**SCREWS**—Link-Belt makes a complete range of conveyor screws—Helicoid, Sectional Flight, Cut Flight, Ribbon Flight, Paddle type and other special types for such

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**HANGERS**—Available in a variety of styles and mountings, with various bearing materials and steel or cast hanger frames.



**TROUGHS**—Link-Belt builds flanged, angle flanged, flared, rectangular, dust-seal, jacketed and drop-bottom types in steel or alloy metals. Variety of connections, supports, covers and clamps offers added design flexibility.



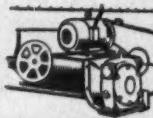
**SPOUTS & GATES**—Plain discharge spouts can be fixed or detachable. Discharge gates, flat or curved slide, can be hand or rack-and-pinion operated.



**SHAFTS & COUPLINGS**—Conveyor couplings and end shafts are designed for adequate torsional strength and have jig-drilled coupling bolt holes for accurate alignment.



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# SIMPLIFY

## Respiratory Protection

### and Inventory with the AO R5000

(One Face Mask—Seven Sets of Cartridges  
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If yours is a multi-respiratory hazard operation, you can streamline the protection problem and the equipment needed to meet it by concentrating on the AO R5000. This twin cartridge respirator converts to many types of protection by interchanging the following cartridges:



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R56—For fumes produced in welding, burning, smelting and refining. B. M. 2163.



R50—For combination of all dusts, toxic, pneumoconiosis-producing, nuisance. B. M. 2156.



R51—For light organic vapors and gases of paint spraying, degreasing, dry cleaning. B. M. 2304.



R53—For combined acid and organic gases like carbon tetrachloride and acetic acid.



R52—For acid gases, and mists of plating operations, pickling tanks, etc.



R54—For protection against low or nuisance concentrations of ammonia.



AO's Industrial Vision Program Increases Production, Decreases Accidents. Write today for booklet, "Improved Industrial Vision".



AO R5000  
RESPIRATOR

YOUR NEAREST AO SAFETY PRODUCTS REPRESENTATIVE CAN SUPPLY YOU WITH THE FACE PIECE AND COMPONENTS REQUIRED TO MEET YOUR SPECIAL NEEDS. HE ALSO SUPPLIES INDUSTRIAL SAFETY GLASSES AND PROTECTIVE CLOTHING.

American Optical

SAFETY PRODUCT DIVISION

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# Only B. F. Goodrich makes the grommet belts that cut costs 20 to 50%!

*Save 3 ways! Investigate today!  
Write or mail coupon*

You save belt costs because belts last longer, save production costs because machines keep running with fewer interruptions, save maintenance costs because they need less attention.

Patented grommet belts by B. F. Goodrich represent the only basic change since invention of the V belt. Belts last 20 to 50 per cent longer, depending on service. (The more severe the service, the greater the increase over ordinary belts.) Grommet belts have more rubber; they're more flexible, give better grip, less slip.

#### *What is a grommet?*

A grommet is like a giant cable except that it's *endless*—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

#### *All cords put to work*

Each of the two grommets and every part of a grommet carry their share of

the load. In ordinary belts under high tension the center cords "dish" because tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. Grommet belts have no center cords, there is no dishing—therefore much more strength in proportion to cord volume—and less stretch. Grommet belts stretch, on an average, only about one-third as much as ordinary belts.

#### *Better grip, less slip*

Grommet belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give  $\frac{1}{3}$  more gripping power, pull heavier loads with a higher safety factor. Because there is less slip, there is also less surface wear.

#### *Send for proof*

Send the coupon for a set of reports telling users' experiences and showing actual installations where grommet belts outlasted all others. Some typical cases:



"...within a few days ordinary belts had stretched... After six months of 24-hour-day service BFG grommet belts haven't stretched at all..."

"Ordinary belts lasted only 5 or 6 weeks... B. F. Goodrich grommet belts are in their sixth month of service..."

"Previous belts suffered from shock loads, wore out fast... BFG grommet belts have been in service 2 years with no shut-downs..."

There are hundreds of cases like these.

#### *They cost no more*

BFG grommet belts cost not one cent more than others. The savings they make for you are clear profit. They are made in C, D and E sections. They are patented by B. F. Goodrich. No other V belt is a grommet belt (U. S. Patent No. 2,233,294).

Write, send the coupon or see your B. F. Goodrich distributor. (He will show you his "X-ray" belt that shows the grommet construction clearly.)

**Grommet V-Belts** BY  
**B.F. Goodrich**  
FIRST IN RUBBER

The B. F. Goodrich Company  
Dept. CE-4  
Akron, Ohio

- Send set of reports telling users' experiences and showing actual installations proving that B. F. Goodrich grommet belts outlast all others.  
 Have distributor show me the "X-ray" belt that shows how B. F. Goodrich grommet belts are made.

Name \_\_\_\_\_

Firm Name \_\_\_\_\_

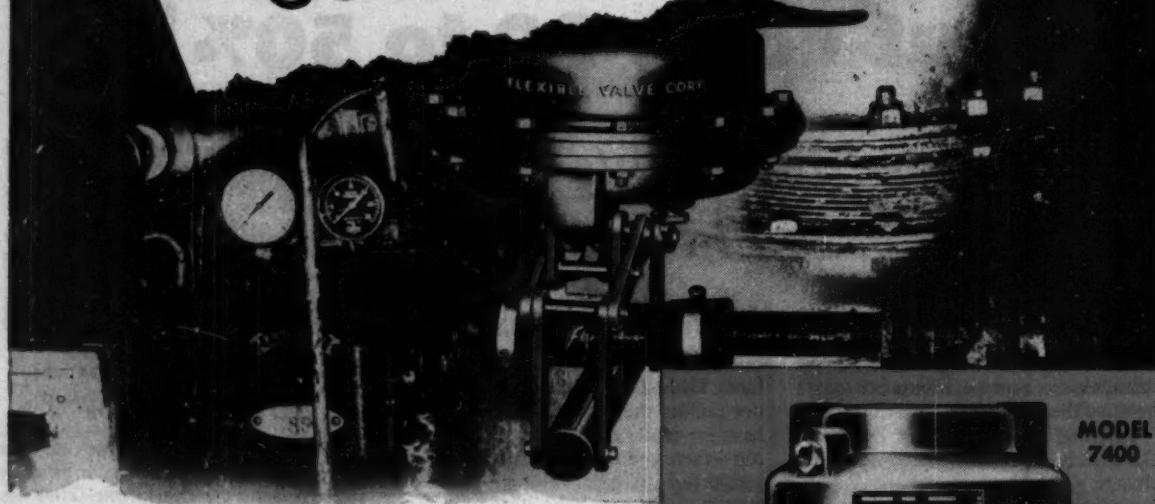
Street Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

CUSTOMER'S QUOTE

"ONLY FLEX VALVE  
COULD DO THIS JOB!"

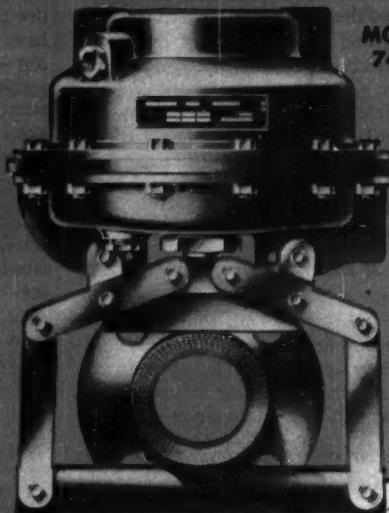


MODEL  
7400

This diaphragm motor-operated Farris Flex Valve is handling a hard-to-convey, semi-solid slurry in a leading chemical processing plant. Before it was installed, other types of valves clogged after as little as a few hours' service. Yet Flex Valve has performed perfectly for more than 3 years, in a 24-hour, 7-day-week operation. Many other Flex Valve installations have been giving trouble-free, continuous service for 15 years or more. If you have a problem in controlling flow of any hard-to-handle fluid, send for Catalog No. FL 382-A.

Exclusive FLEX VALVE Features (Pat'd & Pat. Pending)

- Will outwear any metal valve on abrasive service. Proven minimum 11 to 1 life over metal.
- Full pipe capacity.
- Will not freeze up in outdoor service.
- Excellent control characteristics in first  $\frac{1}{3}$  of travel.
- Complete closure for bubble-air tightness.
- Tight on grits up to  $\frac{1}{8}$ ".
- No obstructions, pockets, or internal parts.
- Valve body available in pure gum rubber, neoprene, butyl, buna-n, buna-s, food stock and special compounds.



We Guarantee  
YOUR MONEY BACK  
if Flex Valve plugs

Representatives  
in Principal Cities

FLEXIBLE VALVE CORP., Palisades Park, N.J., U.S.A.

Affiliates: Farris Engineering Corp. • Farris Stecon Corp. • Farris Hydrossel Corp. • Farris Hydrotorque Corp.

*Another new development using*

# B. F. Goodrich Chemical *raw materials*



*B. F. Goodrich Chemical Co. does not make this plastic pipe. We Supply the Geon resin only.*

**T**HIS rigid polyvinyl plastic pipe is doing a beautiful job of carrying highly corrosive, acidified dilute brine, where other types of hose or pipe caused difficult problems.

For example, when rubber hose was used, it plugged up because the rubber particles carried in the brine tended to stick to the side of the hose. This meant dismantling and unplugging the hose about every three months.

With metal pipe, the rubber particles would stick to the welding. And another type of corrosion-resistant pipe was hard to install and broke easily.

This rigid plastic pipe, made with Geon polyvinyl chloride resin, takes

care of all those problems and more! Pipe like this can be made rigid or flexible, useful for underground or overhead piping to carry liquids or gases.

It resists soil acids or alkalies and electrolysis. No protective coating or wrapping is needed. It can be made light enough for a small boy to lift easily. Polyvinyl plastic pipe is four to six times lighter than steel pipe of equal length, diameter and wall thickness.

To the economies in use and maintenance, add the savings in racking, stringing, handling, freight and shipping costs with plastic pipe like this!

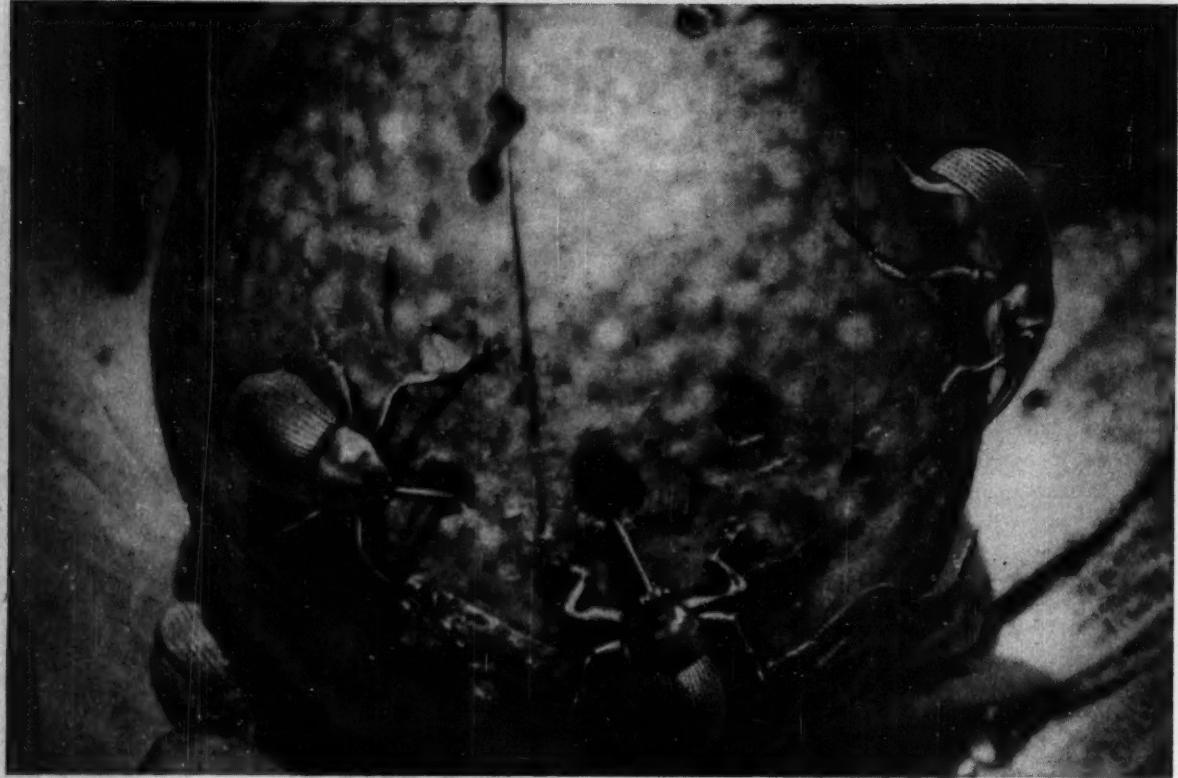
It's another example of how Geon materials help improve or develop

products, and lower costs. Perhaps they can help you. For technical information, write Dept. GE-4, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable.

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON organic colors



## Foiling the beetle with the half-billion bite!

\$500,000,000—that's what those little beetles on the cotton plant above cost America in 1950. The boll weevil adds a whopping \$10.00 a year to the price every one of us pays for cotton goods. Producing four to five generations a season, the female boll weevil first destroys the flower buds of the cotton plant by laying her eggs in them; later generations deposit their eggs in the cotton bolls, where the greedy grubs raise havoc with the silky cotton fibers. The boll weevil is probably the most destructive of all insect pests, and has forced large agricultural areas to abandon the growing of cotton altogether.

Today our most effective weapon against this pest is the new insecticide BHC (benzene hexachloride). So great is the demand for it that the production of BHC increased 300% last year and now equals or exceeds that of any other insecticide. BHC is produced by the controlled chlorination of benzene by means of a catalyst. Its commercial production is made more difficult by the corrosive qualities of the basic ingredients and the temperatures at which the catalyst operates. To handle these corrosives effectively, processors of this insecticide use many ALOYCO corrosion-resistant valves in the plants where they make BHC. Like the makers of benzene hexachloride, manufacturers of

other insecticides such as DDT, Toxaphene, Rotenone, arsenates, and fluorides also depend upon ALOYCO valves for the protection of their products.

ALOYCO valves are supplied in stainless steel and other corrosion-resistant alloys by the Alloy Steel Products Company, Inc., the world's largest specialists in valves for corrosive service. Such concentration has developed a practical knowledge of the chemistry of corrosion, and produced the metallurgical and mechanical know-how to combat it. That's why ALOYCO corrosion-resistant valves are used by many leading firms in the chemical field . . . to handle anything from acetic acid to zirconium tetrachloride.

ALOYCO valves go hand-in-hand with chemical progress.

If corrosives play a part in your business it would pay you to bring your problems of corrosion, contamination, discoloration, or temperature extremes to the *Alloyco Corrosion Engineering Service*. Our engineers and metallurgists will be glad to pre-test various alloys under actual line conditions; our long and diversified experience in this field is available to assist you in selecting the correct valves and alloys to meet your particular requirements. Write us about your own corrosive problems.

37

Longer Lasting  
**ALOYCO VALVES**  
1<sup>st</sup> in Corrosive Service



NEW YORK 1, N. Y.  
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226 West Ninth St.  
PITTSBURGH 22, PA.  
318 Investment Bldg.

### ALLOY STEEL PRODUCTS CO., INC.

1301 West Elizabeth Avenue, Linden, N. J.

Plants: Linden, N. J.; Bloomfield, N. J.; Elizabeth, N. J.

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## How do you measure the look in a puppy's eye?

The preliminary precautions have been taken. A well-recommended kennel. A healthy litter. A breed that takes well to youngsters.

Now it's up to the boy to choose.

How will he decide? Perhaps by the look in a puppy's eye.

Chances are, you'll be buying Multiwalls soon again. You've done as every good buyer does. You've considered the reputation of the various suppliers. You've investigated the quality of their product. You've set down your specifications to the last fraction.

Now you pause to think again of the fellow who will make the final choice—your customer. How will he decide? One

consideration may well be "the look in a puppy's eye." To say it another way, the sales appeal of your package.

Men who know Multiwalls . . . who buy more than 85 per cent of all Multiwalls made . . . give great weight\* to good printing and design.

Union's art directors have concentrated experience. They know how to give your Multiwall package the look it needs to stand out among competition. Volume purchasers of Multiwalls recognize this. They are calling on Union for a greater share of their Multiwall needs.

More so every day . . .

**IT'S UNION FOR MULTIWALLS**

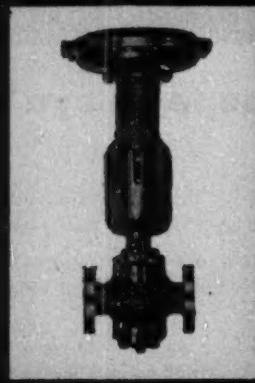
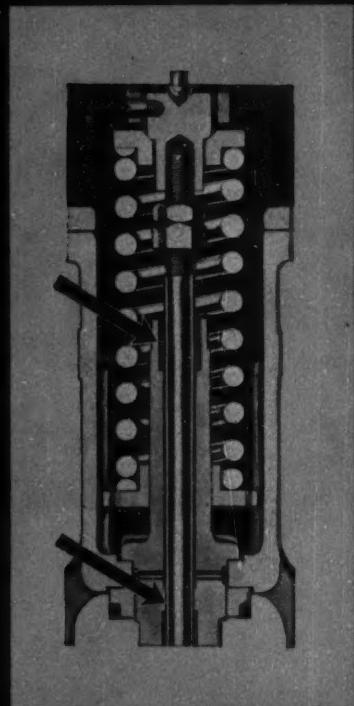


\*August, 1951 research study.

UNION BAG & PAPER CORPORATION • WOOLWORTH BUILDING, NEW YORK 7

**GUIDED STROKE..**

**for smoother stem movement**



The two-point guiding of the upper stem in the Honeywell Series 700 Valve eliminates side thrust by supporting the stem at top and bottom in continuously lubricated bearings assuring practically frictionless response to the slightest changes in signal air pressure. The Honeywell Series 700 wide band proportional valve comes in a full range of styles and sizes has all the features you look for in a fine valve. Write today for your copy of Bulletin 700-2.

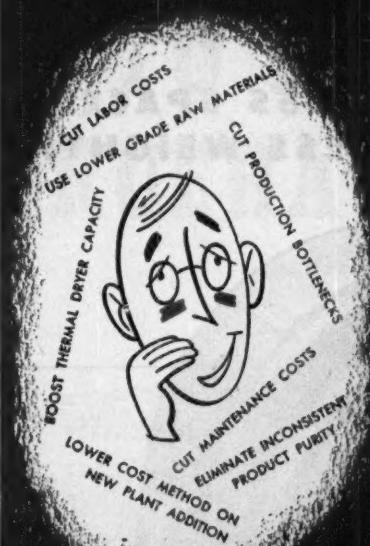
MINNEAPOLIS HONEYWELL REGULATOR CO., *Industrial Division*, 1904 Windrim Avenue, Philadelphia 44, Pa.

MINNEAPOLIS  
**Honeywell**  
VALVE PRODUCTS



*First in Controls*

# Reineveld Centrifuge



The 16" Reineveld Laboratory Centrifuge, installed in Heyl & Patterson's Research Laboratory. This model, particularly designed for laboratory test work, is a valuable tool in plant laboratories for testing and for improving plant processes.

Facilities for testing new products and Reineveld's vast experience will assist you in processing problems. We available to help you determine the value of a centrifuge for your particular application, without obligation.

When you are faced with a processing problem concerning the separation of solids from liquids or the separation of two liquids, call on the test facilities of Heyl & Patterson and the 50 years of Reineveld's centrifugal experience.

Reineveld Centrifuge installations cover all types of products and difficulties from the fast dewatering of free-draining, large tonnage salt crystals to the extra-tough problem of dewatering Anthracene, a slow-draining,

plastic-type crystal.

This abundant experience, combined with actual tests in Heyl & Patterson's testing laboratory, could provide the very answer you are looking for. Or, if your work is confidential, we will gladly offer suggestions for centrifuge testing in your own laboratory.

Whenever you are confronted with new or unusual processing problems, remember Heyl & Patterson testing facilities.

Write for  
Booklet  
10-RC-2

**Heyl + Patterson, Inc.**

"SINCE 1887"

55 WATER STREET • PITTSBURGH 22, PA.



**NEW**

**DODGE-TIMKEN**

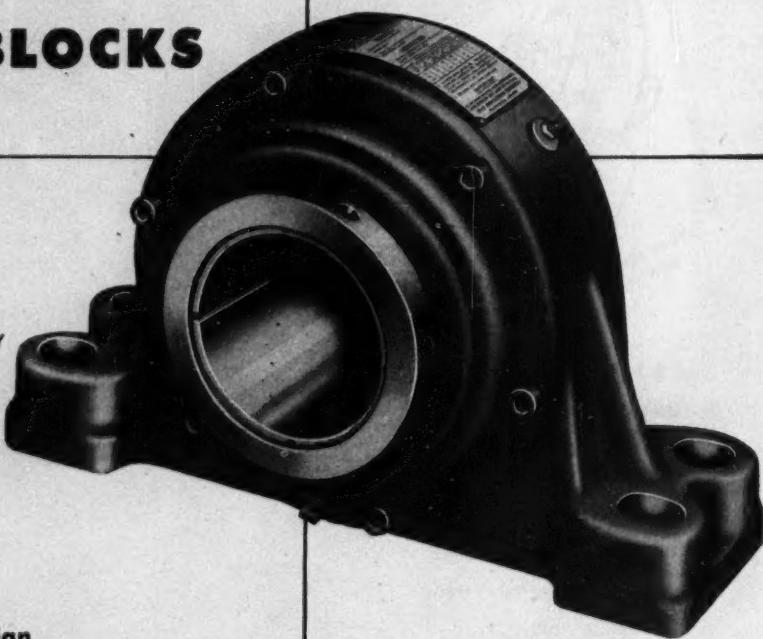
**ALL-STEEL**

**PILLOW BLOCKS**

**HEAVY DUTY  
CAPACITY!**

**LESS SPACE!  
LESS WEIGHT!**

A JOINT ENGINEERING  
DEVELOPMENT BY DODGE AND  
THE TIMKEN ROLLER BEARING COMPANY



- All-Steel construction
- A new Timken bearing design
- High radial and thrust capacities
- Compact—minimum dimensions
- Minimum weight with maximum strength
- Fully self-aligning with spherical outer race
- Both expansion and non-expansion types
- Adapter mounting, proven through the years
- Double piston ring seals
- Sealed both on and off the shaft
- Fully assembled, permanently adjusted, lubricated and sealed at the factory

Here are the bearings for industry's toughest jobs. High radial and thrust capacities. Stamina to take heavy shock loads. And all-steel construction packs this load-carrying capacity into less weight and less space. Engineers are already specifying "Dodge-Timken All-Steel" for some of America's largest projects. Write for details and delivery dates, or call your Dodge Distributor.

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CALL THE TRANSMISSIONEER,  
your local Dodge Distributor. Factory-trained  
by Dodge, he can give you valuable assistance  
on new cost-saving methods. Look for  
his name under "Power Transmission  
Equipment" in your classified phone book.



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FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,  
CHICAGO THRIFTY-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS

# IT PAYS ALL WAYS TO BUY FRUEHAUFS!

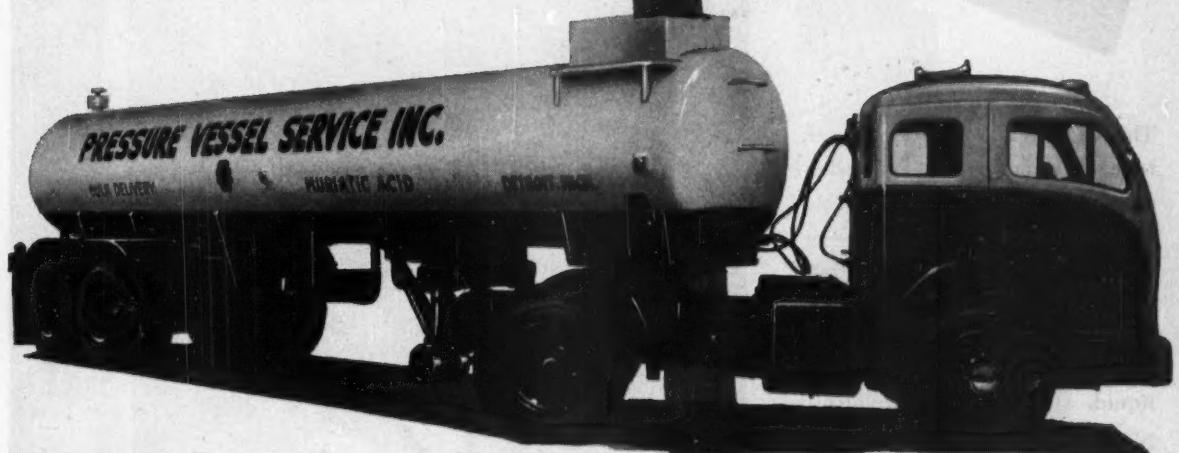
Full Value For Your Money

All The Features You Need

Cost Dependable Performance

Greatest Operating Economy

Cost Experience  
Building Chemical Vessels



BUYING ANYTHING AT ALL brings up the question: "How do I get the best value?" Lowest price and greatest value seldom get together. When you buy a Trailer, for example, make sure its features measure up to your hauling needs. When comparing prices, be sure to compare specifications, too.

We think that, comparing "specs," you will always decide on Fruehaufs. That's because Fruehauf gives haulers *more value* in a Trailer than anyone else possibly can. Fruehauf has the world's most extensive facilities for low-cost, high-quality Trailer production. These savings are handed on to you, along with a Trailer that will do your job, do it best, and do it most *economically*.

Fruehauf has a full line of Tank-Trailers that includes a specially-engineered unit for every type of liquid chemical. For worthwhile hauling savings, for *full* Trailer value, call your nearby Fruehauf Branch soon, or write for the free Tank-Trailer Catalog. If you are not already using Trailers, a Fruehauf salesman will be glad to estimate your possible transportation savings in a free "Transportation Cost Analysis" of your business.

F. A. Nicholson, Manager of Pressure Vessel Service, Inc., of Detroit, says this about his company's new 3800-gallon Fruehauf Tank-Trailer, used for hauling muriatic acid to industries in the Detroit area: "Although Fruehauf's price for this unit was not the lowest, the Trailer was designed to meet *all* our hauling problems and needs. Our purchase was influenced by the integrity of the Fruehauf name, and the convenience of Fruehauf Factory Branch Service." The unit is frameless, and rubber-lined, with an outside coating of corrosion-resistant Epoxy.

*World's Largest Builder of Truck-Trailers*

**FRUEHAUF TRAILER COMPANY**

DETROIT 32, MICHIGAN

CHEMICAL ENGINEERING—April 1953



**STARVATION  
DIET**

This LaLabour self-priming centrifugal pump in a midwestern chemical plant handles filtrates containing sulphuric and lactic acids. Operating conditions impose particular difficulties which demand the special ability of the LaLabour.

There is no steady supply of liquid. The intake is frequently pumped dry, starving the system. Still, the LaLabour Type DPL pump is on the job continuously, priming itself and picking up pressure the instant liquid is again at hand. It repeats this cycle with simple, trouble-free dependability as often as necessary.

Wherever you find the "impossible" jobs being done dependably and efficiently, you are likely to find a LaLabour pump. Write for information today.



**ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP**

**LaBOUR**

**THE LABOUR COMPANY, INC. • Elkhart, Indiana, U.S.A.**



# CSC uses *Tri-Sure* Closures to safeguard purity and uniformity

**S**EVEN plants are required to produce the large line of CSC Chemicals. Yet, although these plants produce different products—in different parts of the country—the purity of the output is uniform. And it's *kept* that way—from plant to purchaser—in drums equipped with *Tri-Sure Closures*.

Commercial Solvents Corporation is representative of the large roster of leading shippers which are as exacting in the *protection* of their products as they are in their *production*. So they use *Tri-Sure Closures* to make sure that drum shipments are *safe* from leakage, pilferage and contamination.

Let the *Tri-Sure Flange, Plug and Seal* give you the perfected way—the proven way—to protect your products. Specify *Tri-Sure Closures* on every drum order.

"The "Tri-Sure" Trademark is a mark of reliability backed by 30 years serving industry. It tells your customers that genuine *Tri-Sure* Flanges (inserted with genuine *Tri-Sure* dies), Plugs and Seals have been used.

Always specify  
**Tri-Sure**  
Reg. U. S. Pat. Off.  
**CLOSURES**  
on drum orders



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Tri-Sure Products Limited, St. Catharines, Ontario, Canada

# Baker Platinum Laboratory Ware



Production of platinum-laboratory ware has been a specialty of ours for almost three-quarters of a century, and we have devoted a great deal of research and experiment to improving it.

This work has been aided greatly by the fact that we maintain and operate large scientific laboratories and use our own platinum ware in them.

Thus, the ware is subjected to day in, day out tests through use, and practical experience has wrought about a number of improvements, among which are:

Improvements in metallurgical processes which have increased its useful life — development of the platinum-rhodium alloy which is now so widely used — design changes like the reinforced rim on crucibles and dishes — development of the low form crucible — improvements in the design of platinum electrodes.

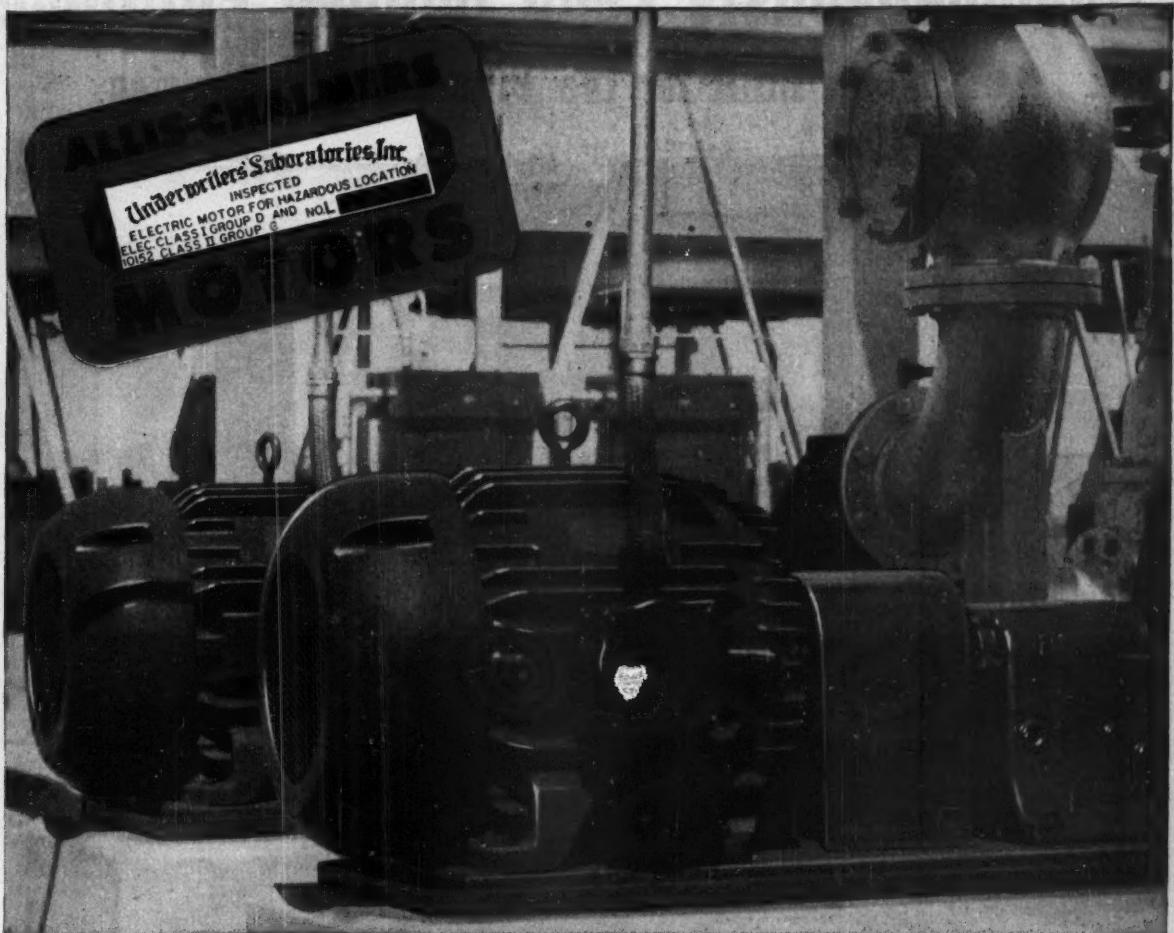
You run no risk in making Baker Platinum Laboratory Ware standard equipment.

**BAKER & CO., INC.**  
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NEW YORK

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## Get These 3 Low Maintenance Features

### 1 Wide Open Air Flow

No enclosed external air passages to clog. Easy to clean with cloth, brush, air hose or vacuum. Simply remove fan cover and whole radiating surface is exposed for inspection and cleaning.

### 2 Cast Iron Construction

Frame, conduit box and fan cover of cast iron resist corrosion. Fan is non-sparking, corrosion-resistant material. Well suited to outdoor operation.

Texrope and Vari-Pitch are Allis-Chalmers trademarks.

### 3 Pre-lubricated Bearings

Ball bearings are double-shielded type, pre-lubricated at the factory. Periodic lubrication is not required under normal operating conditions, but provision is made for in-service lubrication if necessary.

**G**E T COMPLETE INFORMATION ON Allis-Chalmers motors for indoor and outdoor chemical plant service—complete with Allis-Chalmers coordinated control—from your nearby Allis-Chalmers Authorized Distributor or District Office, or write for Bulletins 51B7286 and 51B7149, Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4004

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Applied . . .

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by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.



**CONTROL** — Manual, magnetic and combination starters; push button stations and components for complete control systems.

**TEXROPE** V-belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.



**PUMPS** — Integral types from  $\frac{1}{4}$  in. to 72 in. discharge and up.

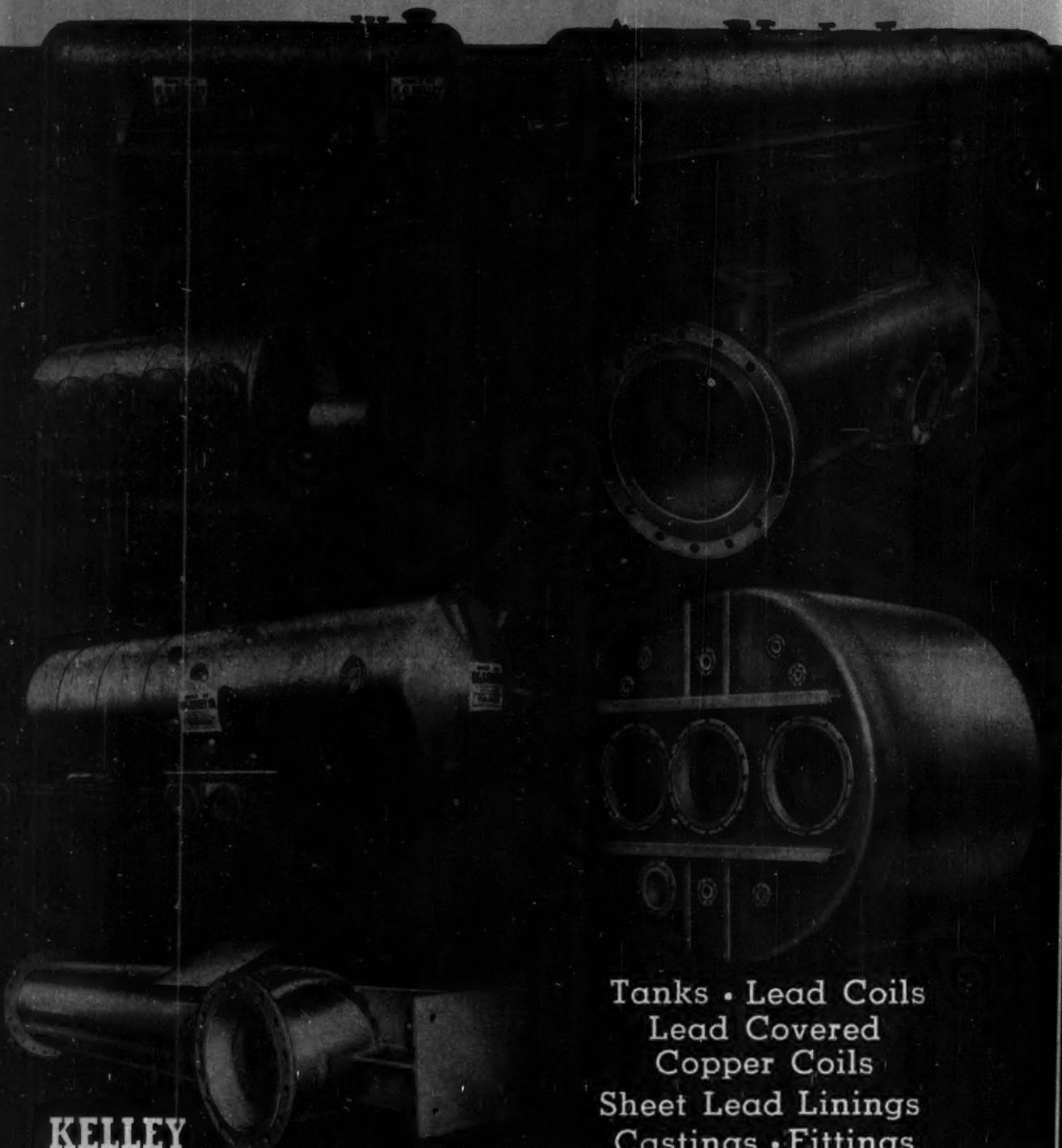


# ALLIS-CHALMERS



# Homogeneously Lead Bonded Equipment

## Custom Built for the Processing Industries



Tanks • Lead Coils  
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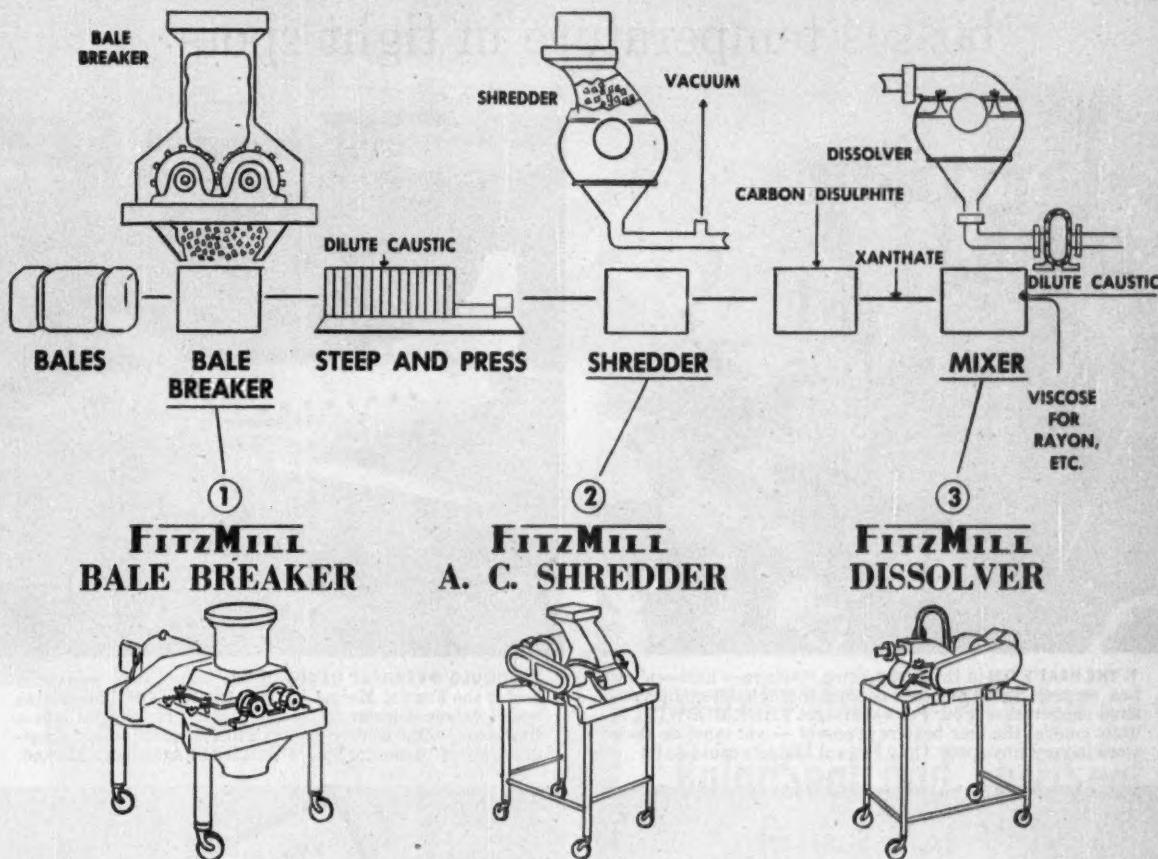


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The complete line of FITZMILL COMMINATORS — HOMOLOIDS — THERMINATORS — RIVERS and TRITULATING units provide operations complementing each other for maximum performance.

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INTIMATE BLENDING . . . FINISHING . . . THOROUGH WETTING . . .  
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SLURRIES . . . EMULSIONS . . . MILLING . . . SUSPENSIONS.**

**Stainless — non-corrosive — dustless — temperature control — sterile — compact —  
maintenance free — abrasion resistant — mobile.**

**Write us for details . . .**

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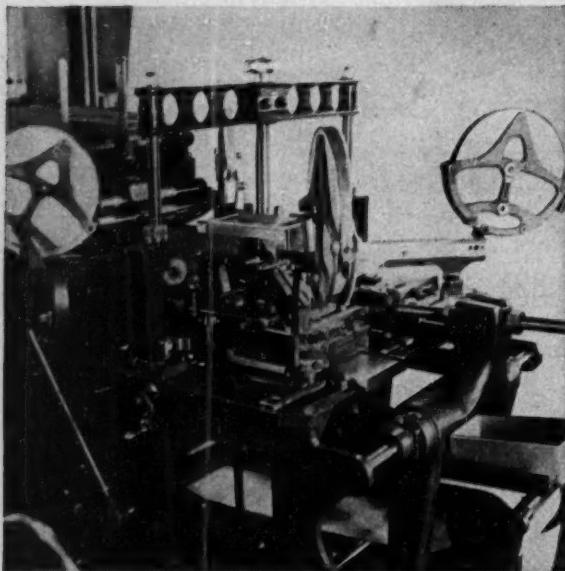


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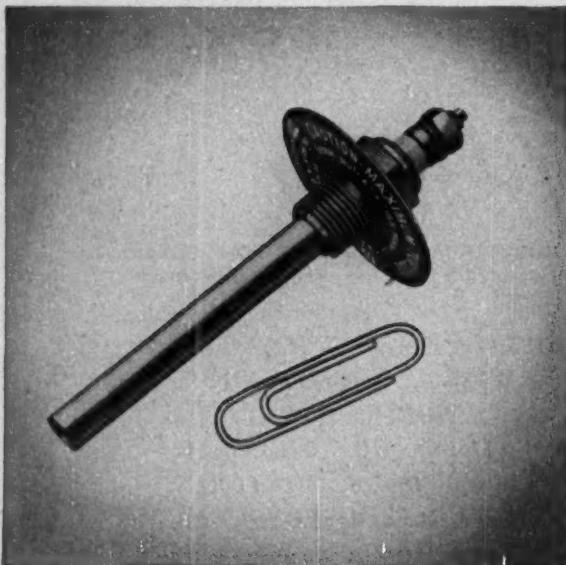
# Mighty Midget THERMOSWITCH® Unit bosses temperature in tight spots



**1. THE HEAT'S ON** in this box making machine — heat-sealing box corners. Speed of boxes passing through determines desired temperature. Four Fenwal Midget THERMOSWITCH units control the four heaters precisely — yet must do their work in very tiny space. Only Fenwal Midgets could do it!



**2. SHOULD OVERHEAT OCCUR** in this transport plane's cabin heater the Fenwal Midget THERMOSWITCH Thermostat would detect it instantly and positively. It snuggles into a tiny space — the heating system's fuel accessories box; measures only  $\frac{1}{4}$ " diameter by  $3\frac{1}{8}$ " but does its job like a Marine.



**3. THE SHELL TELLS ALL** on a Fenwal THERMOSWITCH because the shell itself is the heat-sensitive element. It expands or contracts instantly when a temperature change occurs, opening or closing electrical contacts. It is rugged, resistant to corrosion and vibration, compact and always dependable. This is why they are in use on so many control and safety devices.



**4. FOR FREE BULLETIN** on Fenwal Midget THERMOSWITCH units just write. It gives detailed information and engineering specifications on this new versatile THERMOSWITCH unit for use in confined spaces. Fenwal engineers are glad to assist on your application problems. **Write Fenwal Incorporated, 164 Pleasant St., Ashland, Mass.**



**THERMOSWITCH®**

Electric Temperature Control and Detection Devices

**SENSITIVE...but only to heat**

April 1953—CHEMICAL ENGINEERING



for economical

positive\* safety...

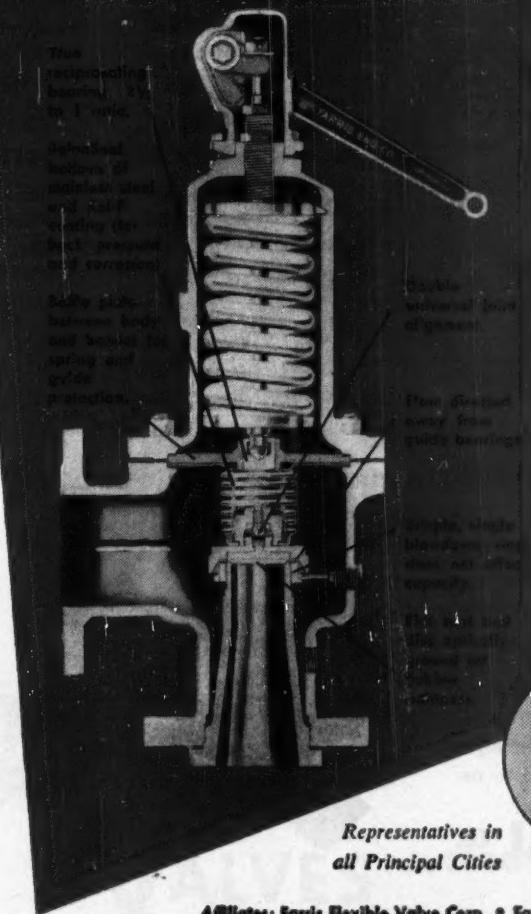
## BalanSeal and FarriSeal Safety-Relief Valves

(Pat'd & Pat. Pending)

Eliminate all risk of failure—failure that might cost lives or severe damage to equipment. Rely on the only safety-relief valves guaranteed to provide positive protection, 100% of the time, under all operating conditions. Farris safety-relief valves can't stick, plug or corrode because the critical working parts are completely isolated from the lading fluid—and they're unaffected by back pressures in the discharge manifold. These unique valves are more economical, too, because they permit higher downstream pressure with smaller discharge piping. In many installations this saving in piping costs amounts to as much as 15 times the cost of the valves. You can't go wrong with BalanSeal or FarriSeal Valves because they can't go wrong!

Technical manual, 51B, a treatment on Back Pressure Piping and Surge characteristics and 76-page catalog is yours for the asking.

\* ASME-N.B. APPROVED  
(Certified for Capacity)

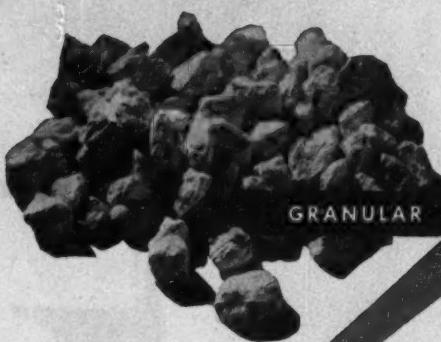
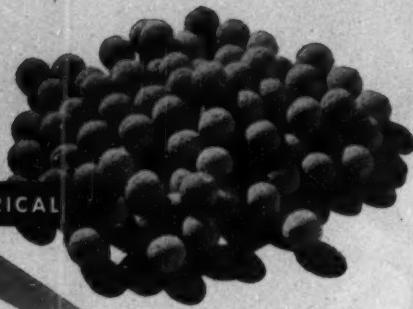


Representatives in  
all Principal Cities



ENGINEERING CORPORATION  
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PALISADES PARK, NEW JERSEY

Affiliates: Farris Flexible Valve Corp. • Farris Stacon Corp. • Farris HydroTorque Corp. • Farris HydroSeal Corp.



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Catalysts  
made to order



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In 1938, Harshaw first began the manufacture of catalysts to customers' specifications. From a few catalysts for a few processes in 1938, Harshaw has continuously magnified its efforts until at the present time we manufacture, to specification, dozens of catalysts for many different important manufacturing processes. We have solved many individual catalyst problems, and are ready to apply our depth of experience and large production facilities to any catalyst development problem which may be presented to us.

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**PREFORMED  
CATALYSTS  
to Fit Special  
Process Requirements  
for**

Hydroforming	Dehydration
Cyclization	Desulphurization
Oxidation	Alkylation
Dehydrogenation	Isomerization
	Hydrogenation

### TYPICAL CATALYSTS

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Boron Fluoride Addition Compounds	
Boron Trifluoride	
Hydrofluoric Acid Anhydrous	

Alumina	
Chrome Alumina	
Molybdena Alumina	
Tungsten Alumina	
	Cobalt
	Copper
	Magnesia
	Nickel
	Vanadium



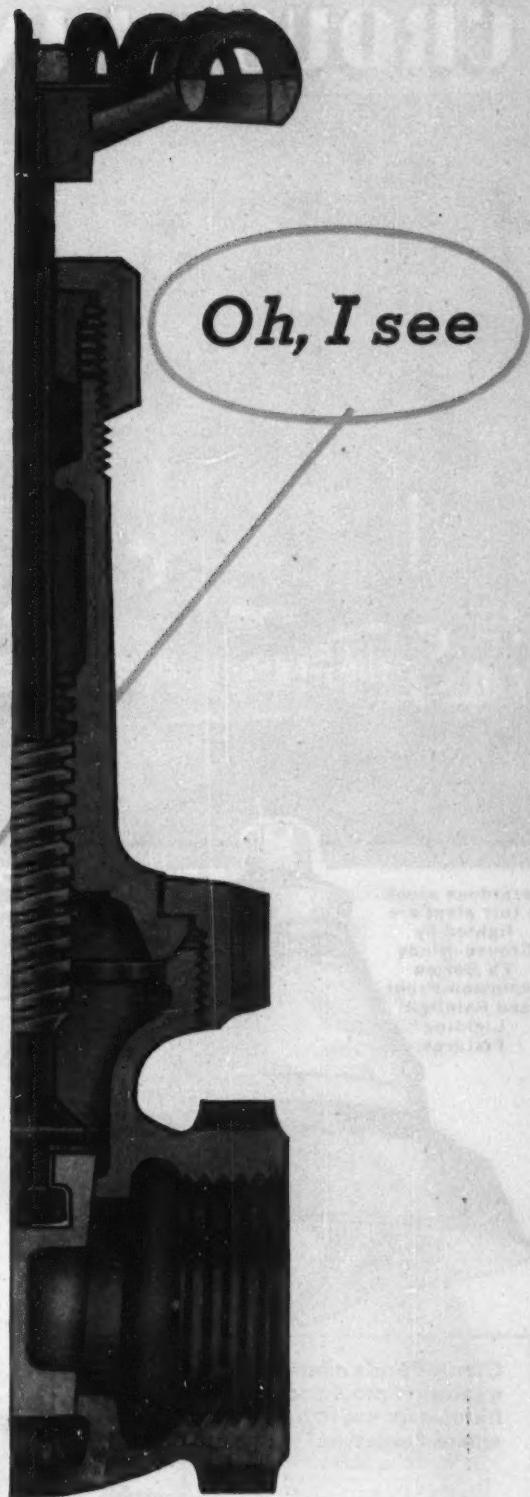
**This valve  
is packed with  
70 years'  
experience**

OIC's "7200 Line", the bronze valve that 70 years' experience built, incorporates the most advanced engineering, superior workmanship and the finest materials... its union bonnet, copper-nickel wedge and long-wearing OIC Alloy 40 stem, for example. You see the difference in the dependability, economy and long, maintenance-free life which OIC Bronze Valves give you.

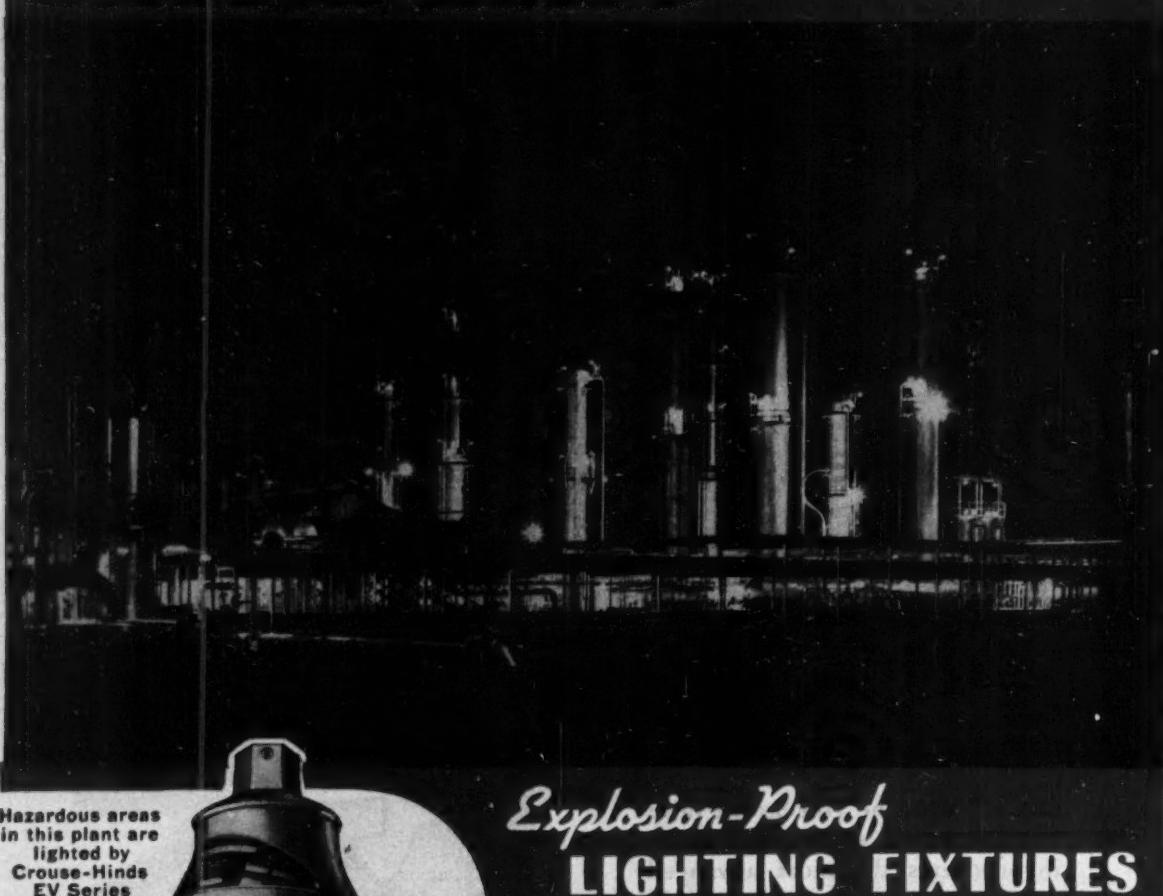
**THE OHIO INJECTOR COMPANY  
WADSWORTH, OHIO**



**VALVES . . . FORGED & CAST STEEL, IRON & BRONZE**



# CROUSE-HINDS



Hazardous areas  
in this plant are  
lighted by  
Crouse-Hinds  
EV Series  
Explosion-Proof  
and Raintight  
Lighting  
Fixtures



Crouse-Hinds offers a complete line of explosion-proof and dust-tight lighting fixtures for use in hazardous locations where fluorescent lamps are desired.



## Explosion-Proof LIGHTING FIXTURES

... EXCEED the requirements  
for service in  
highly explosive atmospheres

To be safe for use in such locations, the fixture must operate at a temperature below the ignition temperature of the gas-air or vapor-air mixture. Also, the fixture must be so strong that it will resist internal explosions without damage and so tight that it will prevent the escape of flames or burning gases which might ignite the surrounding atmosphere.

Crouse-Hinds EV Series explosion-proof and raintight industrial lighting fixtures meet all of these requirements PLUS a wide margin of safety for extra protection.

Complete listings are in Crouse-Hinds Condulet Catalog.

## CROUSE-HINDS COMPANY Syracuse 1, N. Y.

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver  
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Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.



CONDULETS • TRAFFIC SIGNALS • AIRPORT LIGHTING • FLOODLIGHTS



# LADISH

*Controlled Quality*  
**PIPE FITTINGS**  
offer dependability  
safeguarded by  
advanced metallurgy

Year after year... in all kinds of service... Ladish Controlled Quality Fittings set new standards of reliability. One reason is the strong reliance on technical progress. Every new facility and advanced technique of modern metallurgy is fully utilized to develop desirable physical properties to maximum limits... while unrelenting test procedures continuously safeguard metallurgical soundness and provide users with authentic data proving the complete dependability of every Ladish Fitting.



TO MARK PROGRESS

THE COMPLETE *Controlled Quality* FITTINGS LINE  
PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

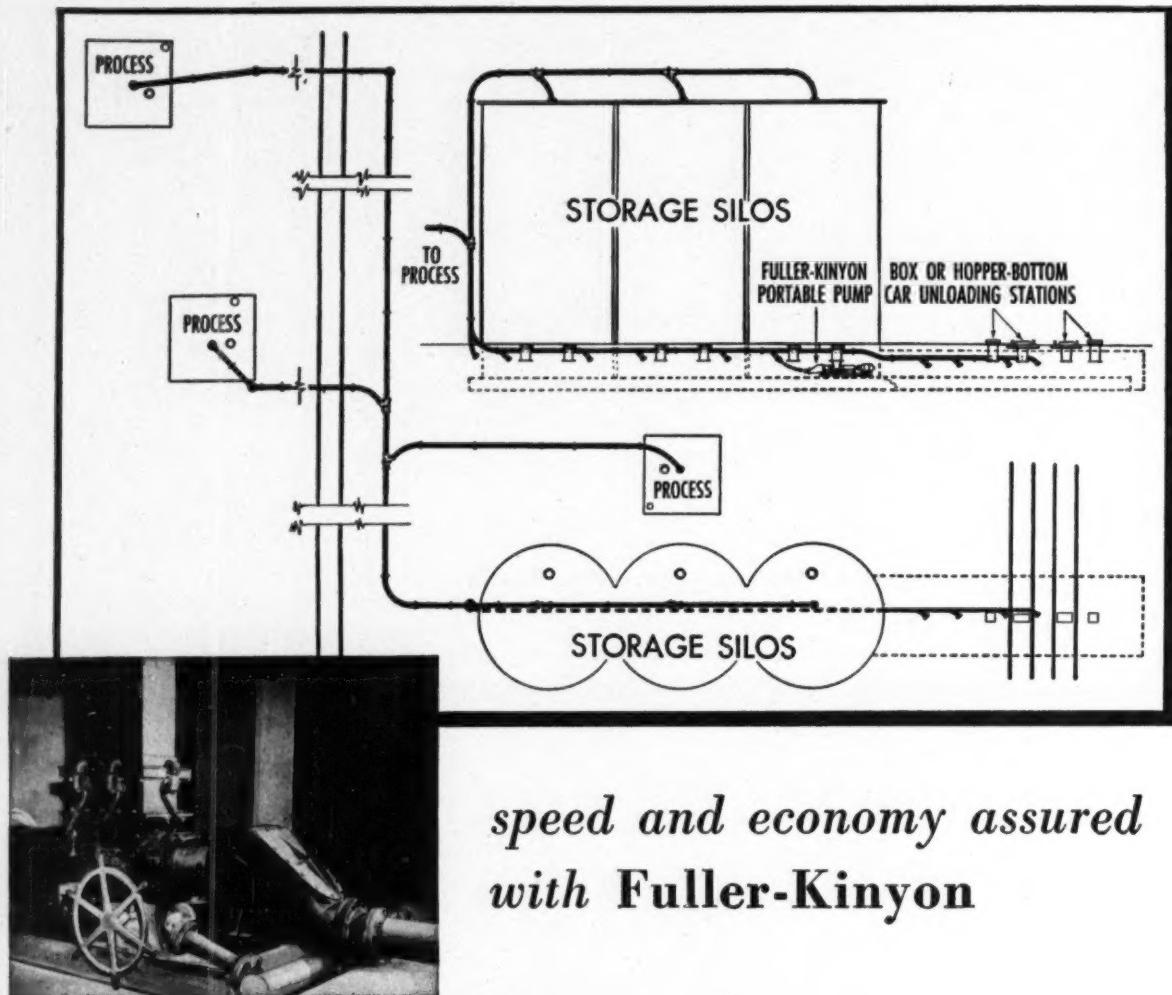
**LADISH CO.**

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16" XH LADISH ELL Q WPB EWS





*speed and economy assured  
with Fuller-Kinyon*

Deep in the heart of Texas, this Fuller-Kinyon Conveying System is at work handling bulk shipments of pulverized phosphate rock from cars to storage, for a prominent chemical company.

This same portable Fuller-Kinyon Pump, in addition to unloading from box or hopper-bottom cars, on adjacent tracks, and delivering to any one of three storage silos, can be moved on a track to positions underneath these silos. Connection is easily and quickly made to the silo to be emptied and material conveyed to any one of three widely separated process points in the plant.

Advance designing makes this dual use of the Fuller-Kinyon Pump feasible.

Conveying is done at the rate of 50 tons an hour, with the longest conveying distance approximately 690 feet; together with branch lines making a total of about 1070 feet.

A Fuller Rotary Single-stage Compressor furnishes the necessary air to the Fuller-Kinyon Pump for conveying.

If you handle bulk shipments of dry, pulverized materials it will be worth your while to learn about Fuller air conveying systems now. Write today!



**FULLER COMPANY, Catasauqua, Penna.**

*Branch Offices*

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P-147  
1844

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS . . . COMPRESSORS AND VACUUM PUMPS . . . FEEDERS AND ASSOCIATED EQUIPMENT

# PROSPERITY IN THE USA: How Deeply in Debt Are We?

How prosperous are the people of the United States? Previous messages in this special series have answered this question in part by recording the progress—relatively slow progress—we have made in increasing both the income and the wealth per person in the USA.

This fourth and concluding piece of the special series deals with the extent to which our prosperity should be discounted because it has been accompanied by an increasing volume of debt. Many correspondents have suggested to us that an individual or a nation can temporarily increase prosperity by borrowing, but in so doing lives on both borrowed goods and borrowed time. Our purpose here is solely to throw light on the question of whether or not we are now in that unenviable position.

On January 1, 1953, the total debt of the United States government and of its citizens was \$627 billion, as shown in the table below. On its face, a debt of this magnitude, which represents about \$3,900 of debt for each person, suggests that we are heavily debt-ridden.

#### TOTAL DEBT — PUBLIC AND PRIVATE

Federal government debt.....	\$267 billion
State and local debt.....	30 "
Private debt	
Corporations .....	195 "
Individuals .....	135 "
	\$627 billion

The burden of our debts, however, does not depend simply on their size. It depends in much more decisive degree on our capacity to carry the load successfully. This capacity, in turn, is partly a matter of attitude, and attitudes defy objective measurement. A community that gets very jittery about its debts has less capacity to carry its burden successfully than one that does not. But the accurate measurement of jitters, present or prospective, still remains to be mastered.

#### Capacity to Carry the Debt Load

Nonetheless, it is possible to throw some light on our capacity to carry the debt burden by studying key economic elements that can be measured with some degree of accuracy. The following paragraphs indicate how some of these key economic elements stand.

Compared with our national income, the total volume of our debts, public and private, is still well below the level of 1929, when it proved to be too big for the good of the country. Our total debt is now 113% greater than the national income whereas in 1929 it was 146% greater.

There are several other cheering facts about our debts. One is a sharp decline in interest rates which makes the cost of carrying our debts relatively much less than it was in 1929. It took 8% of our total national income to carry our debts in 1929; it takes only about 5% of the income today.

### **More Cheering Facts**

We also have much more ready cash now than in 1929. Today individuals and corporations hold a total of \$269 billion in cash or its equivalent which is almost twice as much as the portion of private short-term debt (about \$140 billion) that is subject to sudden demand for payment.

Many students of the subject cite the relatively low cost of carrying our debts and the large volume of cash on hand, and reach the comfortable conclusion that our debt burden is nothing to worry about. In further support of this view they emphasize the fact that no important part of our debt is owed abroad. Hence, they reason there is not the danger, so conspicuous in Britain since the end of World War II, that our economy will be upset by the necessity of making heavy debt payments to other countries.

### **Some Dangers of Present Debt**

However, the nature of our debts presents dangers that it would be foolish to ignore. This is true of both the debt of \$267 billion owed by the federal government to its citizens and the \$330 billion in private debts owed by some citizens and corporations to others.

Public debt can be a dangerous kind of debt because government has the power to print money or to create its equivalent by expanding bank credit. Of the \$215 billion that the federal government borrowed during World War II, over \$90 billion was borrowed from banks. This was the largest single contributor to the inflation of prices that since the war has robbed the dollar of about half of its purchasing power, and thereby robbed the buyers of government bonds of about half the purchasing power these bonds were supposed to represent.

If, as is quite possible, a new emergency should again require the federal government to borrow heavily while its debt remains so high, it is doubtful that the public would be avid to buy its bonds. Hence, the government might again be forced to resort to the inflationary process of relying on bank credit.

Private debts can be dangerous if the people

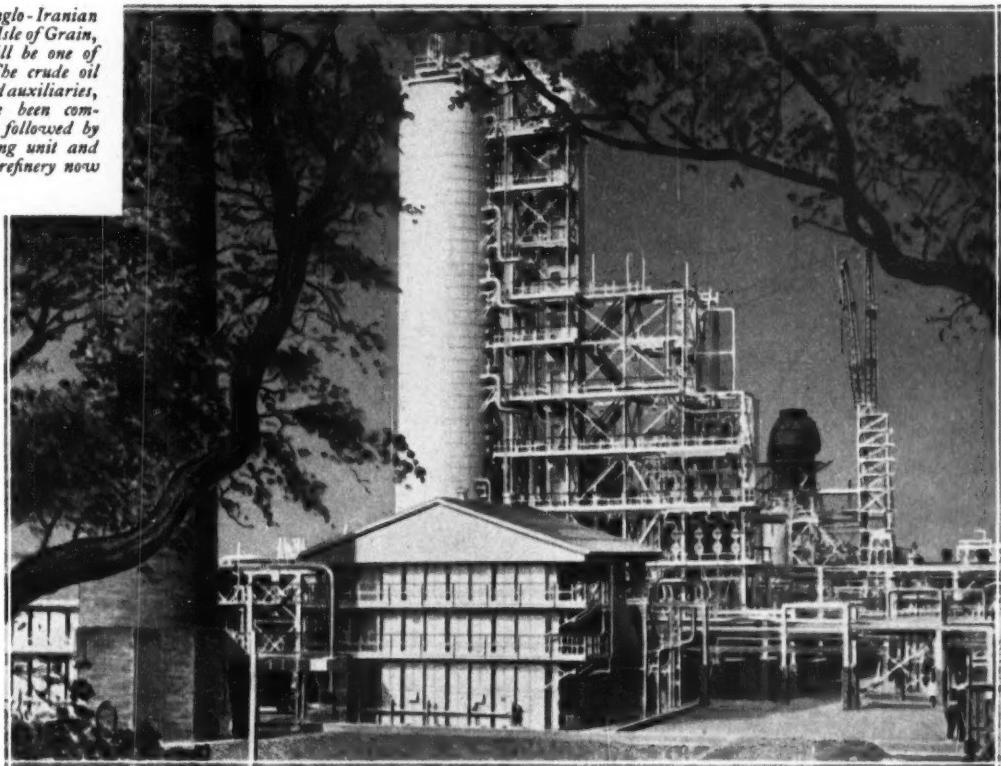
take on new debts more rapidly than is justified by the growth of business or by their ability to repay. Last year bank loans were increased by the imposing sum of about \$6½ billion, which represents an increase of about 11% in total loans outstanding. This is almost twice as much as the increase in the volume of business over the same period. Installment credit for consumers increased by \$3 billion last year, again an increase in debt about twice as great as the increase in business volume in the fields where the credit was used. It is also the fastest rate of such growth in our history.

### **Constructive Use of Credit**

So long as the expansion of credit does no more than keep pace with expansion in the volume of business, the expansion is constructive. Also, when credit is expanded to acquire resources and equipment that will enlarge the volume of business a little later, that use is clearly constructive. But when private credit expansion begins to run ahead of business growth, it is time for us to be heads up. Such credit expansion courts price inflation. It also creates a forced draft under business so that, if credit is cut off, there may be a painful drop.

To give a summary answer to the question: *Is the level of debt in the United States a danger to our prosperity?* — the answer seems to be, "Not at the moment." We owe nothing abroad. The interest burden on present debt is relatively small, and we appear to have the resources to handle the short-term debt. Yet both the total amount of debt and the recent rapid increase in total private debt, especially the latter, are enough to signal for caution. We need restraint on the part of business and consumers to avoid expanding private borrowing at an excessive rate. The federal debt needs to be reduced and put in more manageable form. If these things are done, we can proceed to build a sound prosperity.

Kent Refinery of Anglo-Iranian Oil Company on the Isle of Grain, below London, will be one of Europe's largest. The crude oil distillation plant and auxiliaries, shown here, have been completed and will be followed by the catalytic cracking unit and the lubricating oil refinery now under construction.



## P LACING RESPONSIBILITY *to* BEST ADVANTAGE

Work of the size and complexity of the new Kent Refinery, incorporating the latest technical developments, requires control and leadership woven together detail by detail.

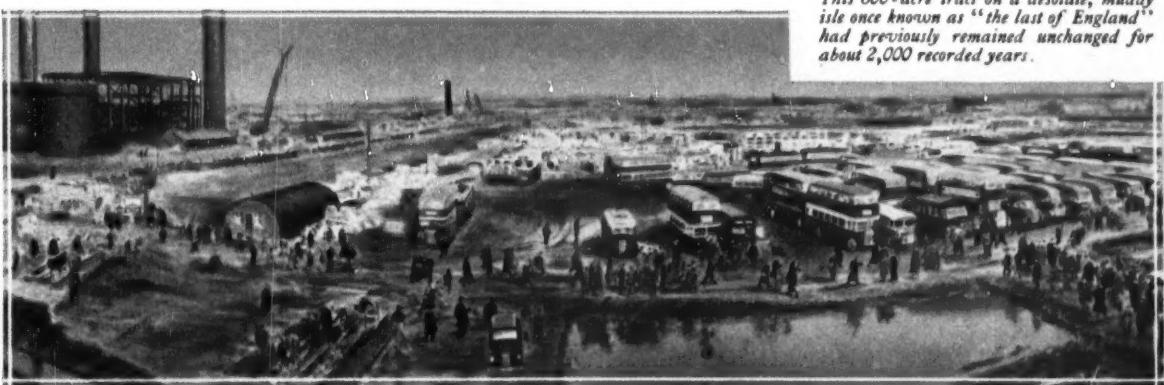
The Anglo-Iranian Oil Company determined products and processes, then placed the design of certain process units and the overall planning and erection management of the complete refinery in the hands of E. B. Badger & Sons Limited, affiliated with Stone & Webster Engineering Corporation.

The coordination of advance planning, scheduling and construction management on a realistic pattern is a sphere in which the organization has long excelled.



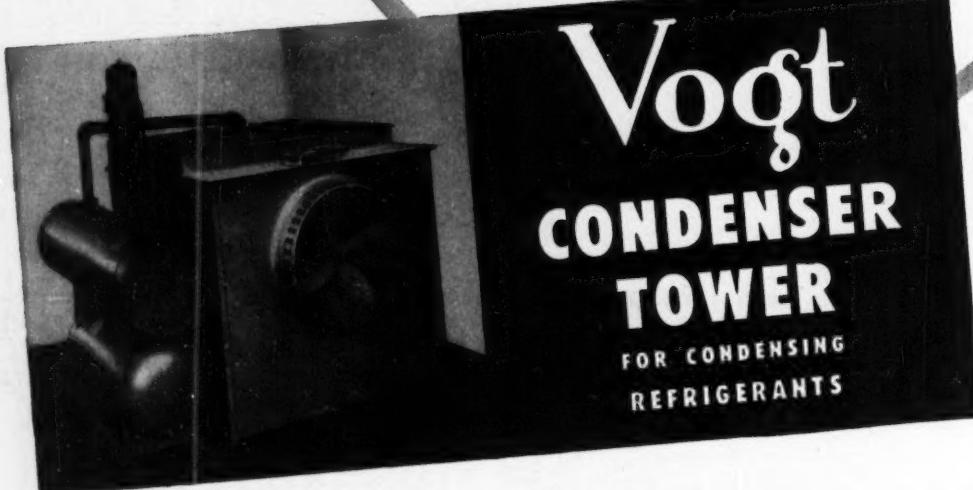
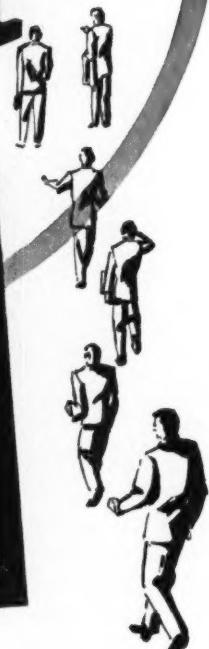
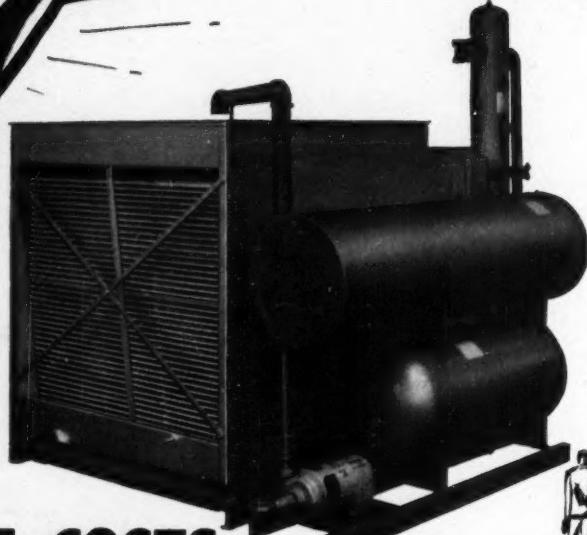
## STONE & WEBSTER ENGINEERING CORPORATION BADGER PROCESS DIVISION

This 600-acre tract on a desolate, muddy isle once known as "the last of England" had previously remained unchanged for about 2,000 recorded years.



*New*  
**SAVES  
WATER  
and  
CUTS  
MAINTENANCE COSTS . . .**

Illustrations show two views of a 35-ton Condenser Tower prior to partial disassembly for shipment.



#### SINGLE RESPONSIBILITY:

Vogt, leading builder of refrigeration condensers, assumes responsibility for engineering the unit. Only one purchase order needed.

#### SHOP FITTED:

To cut down field assembly labor. Requires no cutting or fitting of pipe.

Designed for today's water conservation requirements, and to keep refrigeration costs low, the *new* Vogt Condenser Tower meets the need for a proven, readily cleanable condensing unit.

The Vogt Condenser Tower consists of a multipass straight tube condenser, a receiver, an oil trap, a cooling tower, and a water pump. Removable cast iron heads permit easy cleaning of the condenser tubes.

Water costs are extremely low since the cooling water is recirculated continuously and requires only a small amount of makeup to replace losses due to windage and evaporation.

Condenser Tower units are available in capacities ranging from 5 to 50 tons refrigeration. Additional information will be furnished upon request.

**HENRY VOGT MACHINE CO., Louisville 10, Kentucky**

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

"you  
can't  
beat  
them

# for PROCESS EQUIPMENT"

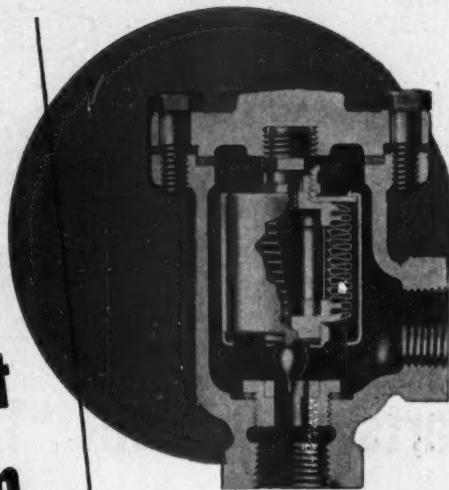
... says Mr. Paul H. Todd, owner of Farmers' Chemical Laboratories, Kalamazoo, Mich.

● MR. TODD has reference to the Sarco Balanced Pressure Thermostatic Steam Traps used throughout his efficient plant, equipped with the finest of modern processing machinery.

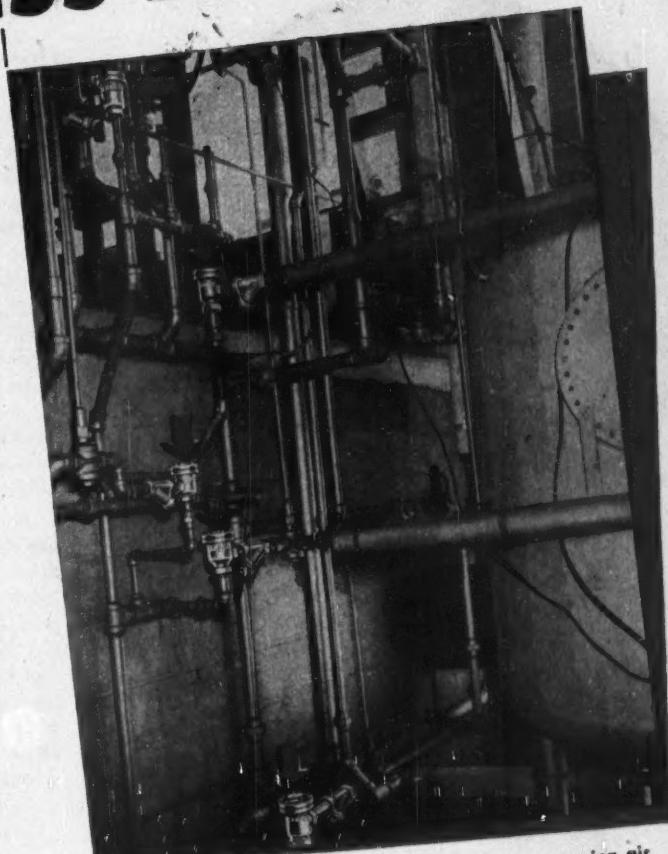
He selected Sarco No. 9 because:

1. Highest capacity per dollar cost.
2. The large discharge valve is wide open when the trap is cold, assuring rapid air venting for quick starts from cold.
3. Small size, low first cost and minimum maintenance make them ideal for individual trapping (a trap on every coil).
4. No adjustments or valve and seat changes are necessary when pressures change. Fewer spare parts to stock.
5. Requires no special protection against freeze-ups when installed outdoors.

For full information write for free Bulletin 250-14 to Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Represented in principal cities. Sarco Canada Ltd., Toronto 8, Ont.



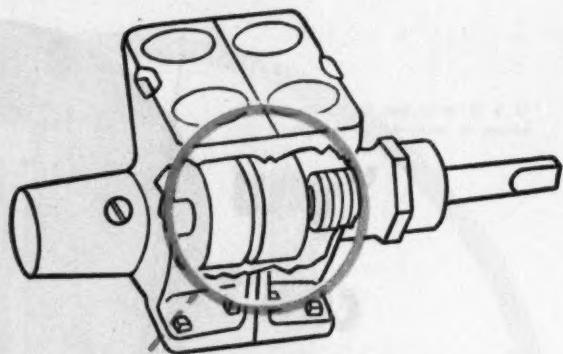
Sarco Balanced Pressure Thermostatic Steam Trap No. 9, available in sizes  $\frac{1}{2}$ " to 2" for pressures to 300 psi. Ideal for individual trapping of process equipment.



Sarco balanced pressure thermostatic traps removing air and condensate from steam coils and supply lines of large vacuum still with reflux column and condenser at plant of Farmers' Chemical Laboratories, Kalamazoo, Mich.

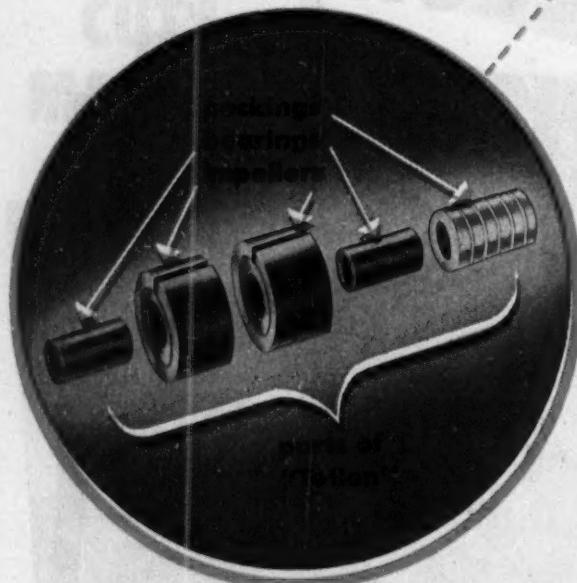
**SARCO** saves steam

improves product quality and output



## Pump parts of Du Pont "TEFLON"

*eliminate erosive pitting...  
mechanical seizure...  
thermal-shock*



Parts of Du Pont "Teflon" made for  
Eco Engineering Co., Newark, N. J.,  
by U. S. Gasket Co., Camden, N. J.

Better Things for Better Living  
...through Chemistry

**Polychemicals**  
DEPARTMENT  
PLASTICS • CHEMICALS

In designing their "Allchem" positive displacement chemical pump, Eco engineers wanted an inert, non-contaminating material for packings, bearings and impellers. The material had to resist galling and erosive pitting . . . eliminate mechanical seizure and thermal-shock breakage.

They found the answer for all three requirements in one material—Du Pont "Teflon"® tetrafluoroethylene resin. "Teflon" is inert to all chemicals except molten alkali metals and fluorine under extreme conditions. It has an extremely low coefficient of friction . . . bearings are self-lubricating. And "Teflon" is mechanically strong . . . impellers withstand high tangential loads.

Even when operated in acids, bearings of "Teflon" are not subject to erosive pitting. The impellers of filled "Teflon" won't gall, shrink, swell, crack, or harden. Packings withstand high pressures and temperatures. According to the manufacturer, the use of Du Pont "Teflon" made possible "—a chemically and biologically inert pump, suitable for the conveyance of a large range of fluid chemicals, in the widest viscosity ranges." And "Teflon" withstands steam or chemical sterilization.

Du Pont "Teflon" has a combination of chemical, electrical, thermal and mechanical properties available in no other single material. Perhaps it can help you improve or develop a product. For further information, write:

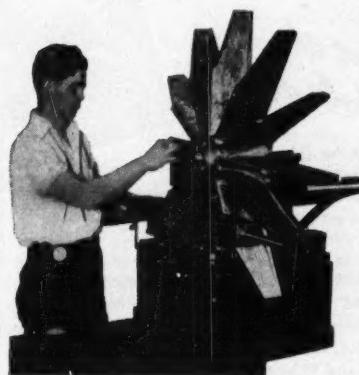
\*REG. U. S. PAT. OFF.

E. I. du Pont de Nemours & Co. (Inc.)  
Polychemicals Department; District Offices:  
350 Fifth Avenue, New York 1, N. Y.  
7 S. Dearborn Street, Chicago 3, Ill.  
845 E. 60th Street, Los Angeles 1, Calif.

# ELLIOTT Centrifugal BLOWERS...



**THEY TAKE  
BRINE-LADEN AIR  
AND LIKE IT!**



The one-piece, open-type, radial bladed impeller is carefully balanced statically and dynamically.

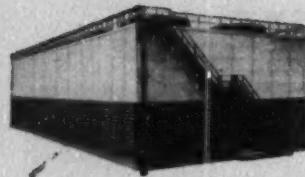
These two Elliott single-stage blowers are installed in the new plant of a well known salt producer, Grand Saline, Texas. Each blower exhausts 15,000 cfm of brine-laden air from a salt filter, compressing from 24.0 to 29.4 in. Hg absolute. To resist the corrosive action of the salt, special materials are used for the impeller, guide vanes, inlet connection and backplate.

The wide experience of Elliott engineers in applying centrifugal blowers to process needs, particularly where corrosive action must be met, has resulted in the selection of Elliott blowers for a preponderance of salt refinery applications, as well as for other difficult services. For full data on Elliott blowers, contact your local Elliott representative, or write Elliott Company, Jeannette, Pa.

## ELLIOTT Company

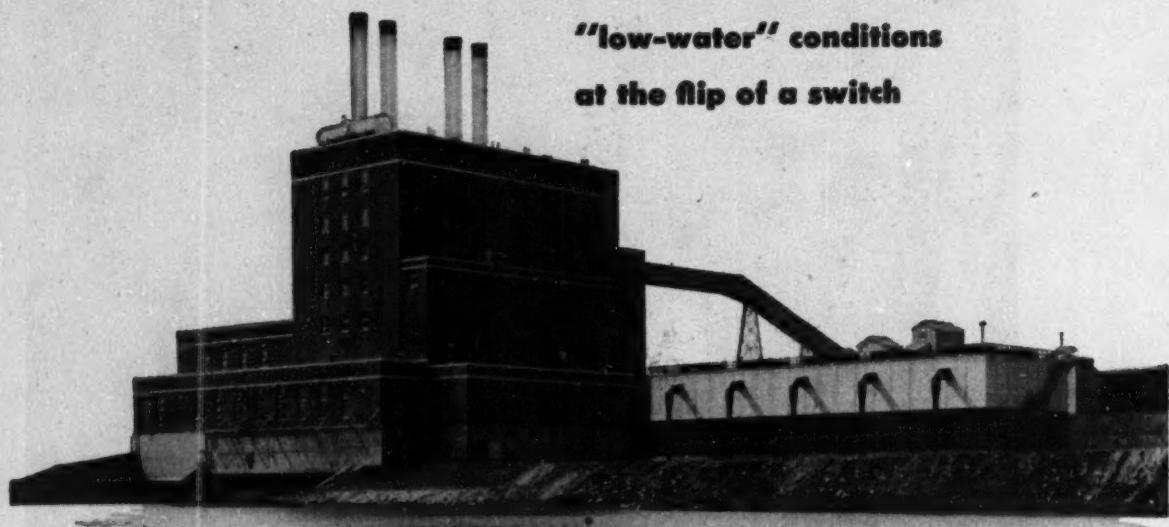
CENTRIFUGAL BLOWER DEPARTMENT





## a standby for nature

—ready to meet  
“low-water” conditions  
at the flip of a switch



This new, ten-cell Foster Wheeler cooling tower was installed by a major southern power company for the sole purpose of meeting their cooling needs when the water level of the river drops too low.

Sheathed with fire-proof asbestos board, this installation cools 50,000 gallons per minute from 114° to 91° F with a spray and evaporation loss of less than 2.5%.

For power generation, oil refining or chemical production—year-round or intermittent operation—there's a Foster Wheeler cooling tower to meet your particular requirements. Each tower is engineered and constructed to give you maximum performance at minimum cost.

*Get the whole story...*



Send for this new, well-illustrated catalog today. Includes helpful information on tower design for freezing climates, effects of recirculation and surroundings on performance, in addition to complete description of sound construction and high-quality materials to which Foster Wheeler customers have long been accustomed.

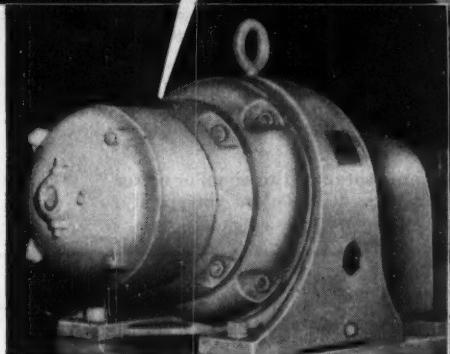
A data sheet is bound into the catalog to aid you in writing the specifications for the cooling tower which will best meet your needs. Write for Catalog CT-52-4 to:

FOSTER WHEELER CORPORATION  
165 BROADWAY, NEW YORK 6, N. Y.

**FOSTER WHEELER**

when a  
here's

job takes guts  
the gearmotor  
that has it....



Here's a Foote Bros.-Louis Allis Gearmotor  
Driving a pay-off reel at the new U. S. Steel  
Fairless mill.

Rugged service and intermittent loading are characteristics of this job and the compact, low-cost, highly-efficient Foote Bros.-Louis Allis Gearmotor was chosen because of its ability to render that service.

These gearmotors incorporate Duti-Rated Gears, with file-hard tooth surfaces and ductile cores, assuring maximum strength with minimum size and weight. Available in single, double and triple reductions, to provide output speeds of 780 down to 7.5 r.p.m.

FOOTE BROS. GEAR AND MACHINE CORPORATION  
4545 South Western Boulevard • Chicago 9, Illinois



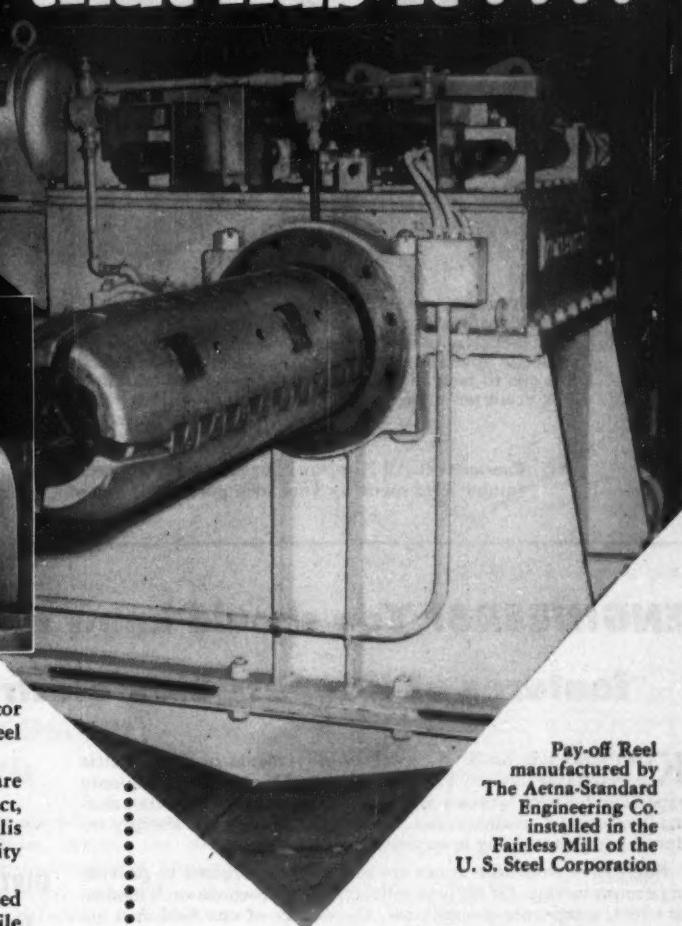
Hygrade  
Drives



Line-O-Power  
Drives



Maxi-Power  
Drives



Pay-off Reel  
manufactured by  
The Aetna-Standard  
Engineering Co.  
installed in the  
Fairless Mill of the  
U. S. Steel Corporation

FOOTE BROS.

*Better Power Transmission Through Better Drives*

FOOTE BROS. GEAR AND MACHINE CORPORATION  
Dept. CE, 4545 S. Western Boulevard, Chicago 9, Illinois  
Please send me Bulletin GMA containing full information  
on Foote Bros.-Louis Allis Gearmotors.

Name.....

Company.....

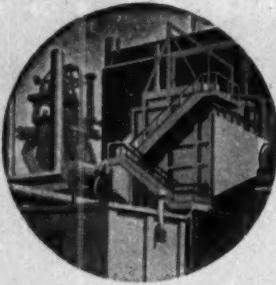
Address.....

Position.....

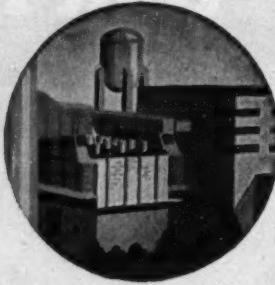
City..... Zone..... State.....

## War on waste!

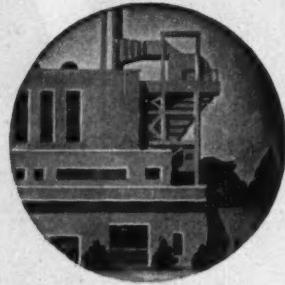
American industry is continually searching for new ways to stop waste and increase production and efficiency. A good example of this is the Koppers-Elex electrostatic precipitator. Shown below are a few typical ways industry uses them to combat waste . . .



**BLAST FURNACE GAS** must be cleaned before it can be used as a fuel. Koppers-Elex electrostatic precipitators clean this gas to residuals as low as .002 grain per cubic foot.



**FLUE GASES** from recovery boilers in pulp mills contain valuable materials. Koppers-Elex electrostatic precipitators recover several hundred thousand dollars worth of these materials yearly.



**FLY ASH** from power plants and factories may drop a blanket of dust extending three to five miles. Koppers-Elex electrostatic precipitators stop this nuisance and preserve public good will.

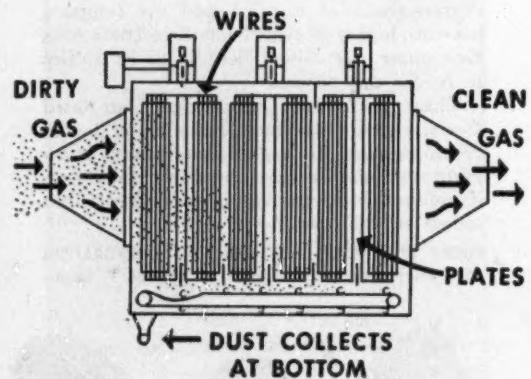
**Guaranteed:** All Koppers-Elex electrostatic precipitators are guaranteed to equal or better (under tests made by your own personnel) any efficiency or residual content you specify.

## ENGINEERS! You should know about these six design features of Koppers-Elex electrostatic precipitators!

KOPPERS has made sweeping improvements in electrostatic precipitator design! For example, double chambers eliminate expensive by-pass systems and the resultant loss of materials during inspection or maintenance. And re-entrainment is sharply reduced because rapping is sectionized.

Successive collection zones are separately energized to provide maximum voltage for highest collection. And because each field is, in effect, a separate precipitator, the outage of one field does not stop gas-cleaning action. In addition, completely enclosed and compact "package" mechanical or vacuum tube power packs simplify installation and operation.

Another exclusive Koppers feature is the drag scraper which provides continuous dust removal, eliminates plugged hoppers and prevents bothersome dust build-up. For detailed information on recovery, gas-cleaning or nuisance abatement results write today to: Koppers Company, Inc., Precipitator Dept., 214 Scott Street, Baltimore 3, Md.

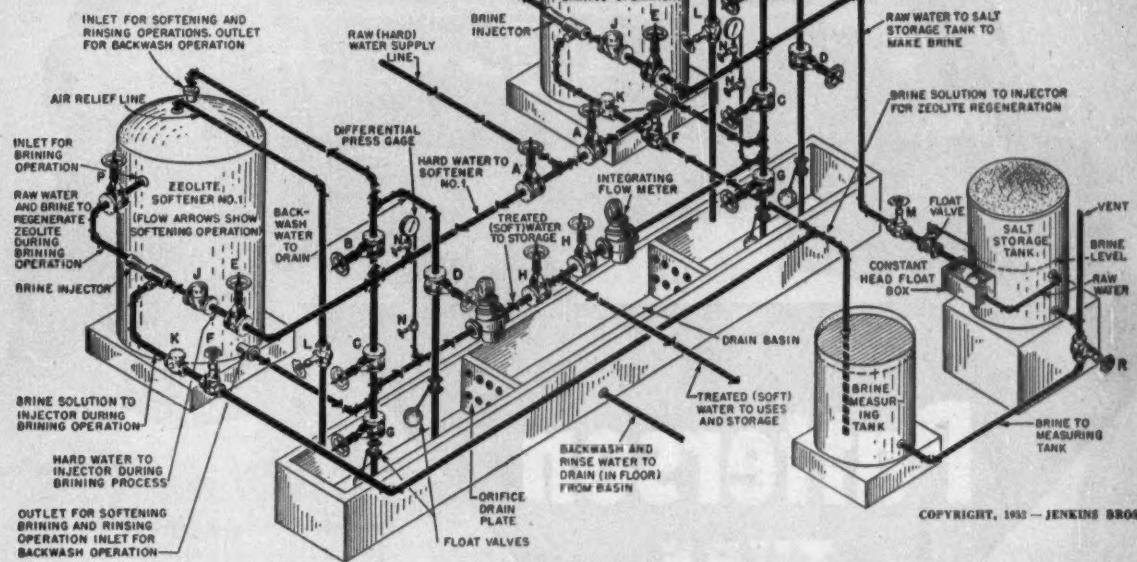


If you have a gas-cleaning problem, write today to: Koppers Company, Inc., Precipitator Dept., 214 Scott St., Baltimore 3, Md.



**Koppers-Elex** ELECTROSTATIC PRECIPITATORS

Operation	A	B	C	D	E	F	G	H
Softening	Open	Open	Close	Close	Close	Close	Close	Open
Backwashing	Open	Close	Open	Open	Close	Close	Close	Close
Brining	Open	Close	Close	Close	Open	Open	Open	Close
Rinsing	Open	Open	Close	Close	Close	Close	Open	Close



VALVE RECOMMENDATIONS  
For details of valves to suit varying conditions, see Jenkins Catalog

## How to plan a ZEOLITE (BASE EXCHANGE) WATER SOFTENING SYSTEM

Diagram shows piping connections for a zeolite water softening system (removal of hard water impurities). Twin softening units permit one to operate while the other is being regenerated, (replacing used sodium in the zeolite).

The complete cycle consists of softening, backwashing, brining, and rinsing. After a certain amount of raw water has been softened, the sodium in the zeolite is used up. The process is then stopped by operating the valves as indicated in the schedule, and the other softening unit is put into operation.

The zeolite is regenerated, after the backwash operation (first step in regeneration of softener), by replacing accumulated calcium and magnesium with the sodium by running through a brine solution. The zeolite is then rinsed after correct amount of brine solution has been admitted.

The rinsing operation also removes any remaining brine, making the softener ready for re-use when needed. Depending upon the chemical composition of the water, either iron-body bronze-mounted or all-iron valves are recommended on all lines conducting the water before it is completely treated.

Consultation with piping engineers is recommended when planning any major piping installations.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from Jenkins complete line. It's your best assurance of lowest cost in the long run. Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 62.

Code	Ques.	JENKINS VALVES	SERVICE
A	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Raw Water Supply to Softener
B	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Control of Cycle Operations
C	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Control of Cycle Operations
D	2	Fig. 651 I.B.B.M. Gate or Fig. 100 All Iron Gate	Backwash Drain Line
E	2	Fig. 100 All Iron Gate	Injector Water Shut-off
F	2	Fig. 40-A All Iron Gate	Brine Control to Injector
G	2	Fig. 651 I.B.B.M. Gates	Brine and Rinsing Operation Drain
H	2	Fig. 651 I.B.B.M. Gate	Softened Water Shut-off
J	2	Fig. 624 I.B. Swing Check or Fig. 85 All Iron Swing Gate	Prevent Backflow
K	2	Fig. 623 I.B. Swing Check or Fig. 85 All Iron Swing Gate	Prevent Backflow
L	2	Fig. 106-A Bronze Globe	Air Release
M	1	Fig. 106-A Bronze Globe	Water Supply for Brine
N	4	Fig. 743-G Bronze Needle	Pressure Gauge Control
P	2	Fig. 100 All Iron Gate	Brine Connection Shut-off at Softener
R	1	Fig. 40-A All Iron Gate	Brine to Measuring Tank

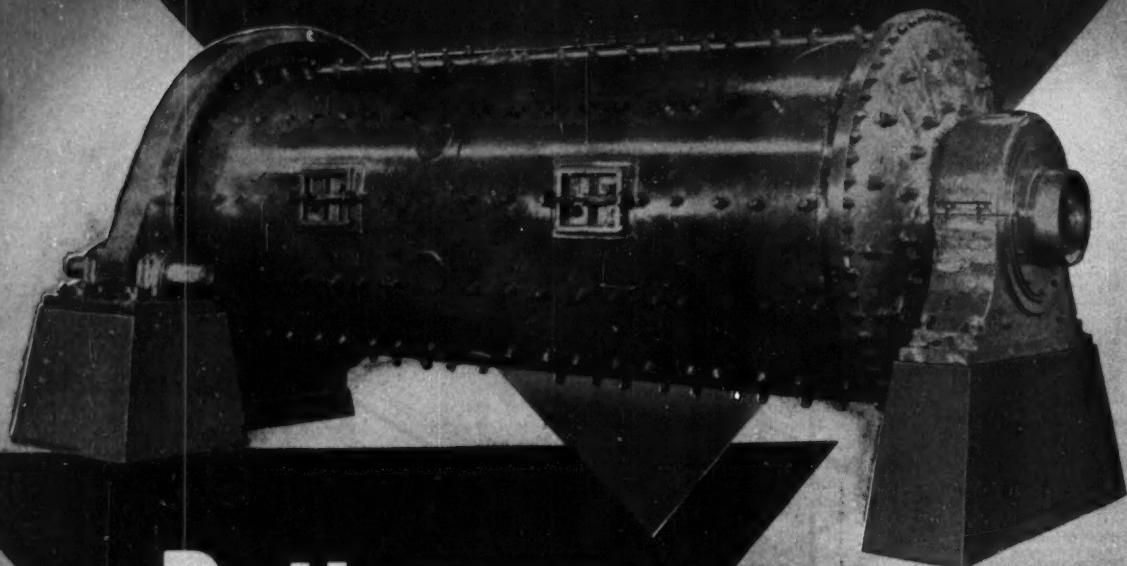


HERE'S

HEAVY DUTY

# Continuous Grinding

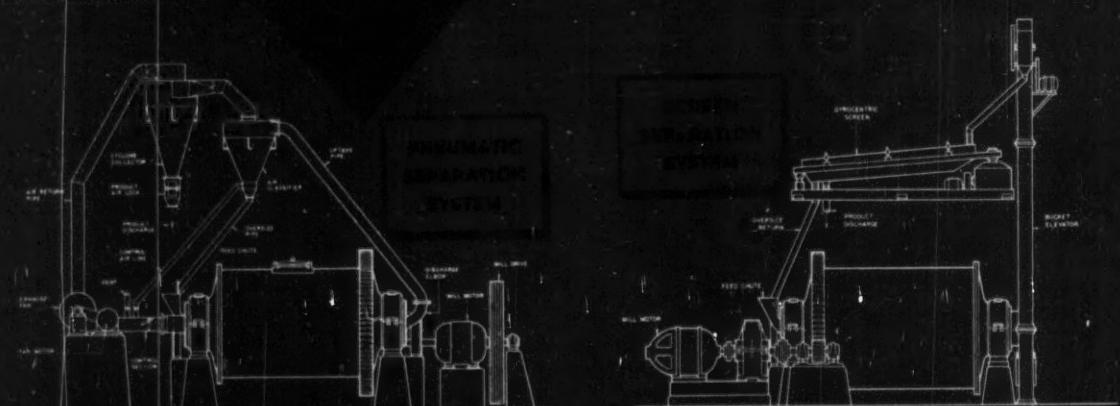
A HOST OF MATERIALS  
IN CHEMICAL PROCESSING



## Patterson TUBE MILLS

Built for continuous operation and trouble-free long life in spite of the most punishing service conditions, these rugged Mills grind many materials from Aluminum to Zircon . . . in closed circuit, with either screen or pneumatic separation. For producing a uniform product at lower cost, check Patterson—we'll gladly cooperate with you.

*Richard L. Cannon*  
President



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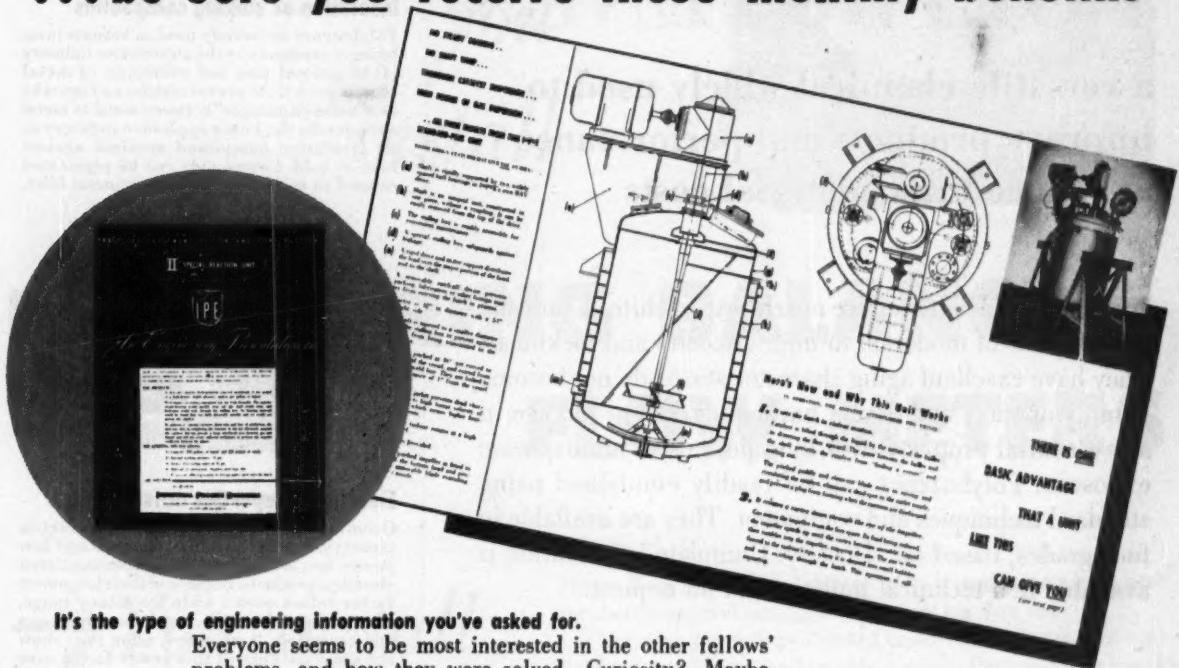
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Since you're not always free to have an Industrial Process Engineer sit down with you to discuss how I★P★E's equipment is designed and built to solve particular processing problems, these bulletins present the kind of case-history information you want.

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# Oronite POLYBUTENES

**a versatile chemical widely used to improve products and performance at reduced raw material costs**

**Properties:** Polybutenes are nearly water-white chemically inert liquids of moderate to high viscosity and tackiness. They have excellent aging characteristics—do not become gummy or waxy and do not harden, darken or change in any essential property over long periods of atmospheric exposure. Polybutenes can be readily emulsified using standard techniques and equipment. They are available in four grades, based on viscosity. Complete information is available in a technical bulletin sent on request.

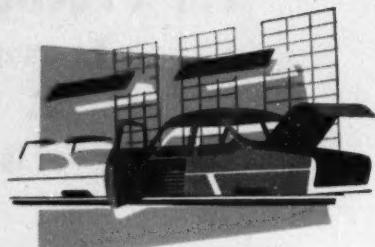
*A partial list of Oronite Products*

Detergent Alkane  
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Detergent D-60  
Dispersant NI-O  
Dispersant NI-W  
Wetting Agents  
Lubricating Oil Additives  
Cresylic Acids  
Gas Odorants  
Sodium Sulfonates  
Purified Sulfonate  
Polybutenes  
Naphthenic Acids  
Phthalic Anhydride  
Ortho-Xylene  
Xylol  
Aliphatic Acid  
Hydroformer Catalyst  
Dispersant FO  
(Domestic Fuel Oil Inhibitor)



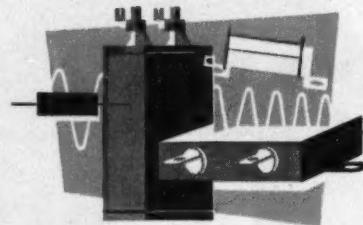
**ORONITE CHEMICAL COMPANY**

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30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK  
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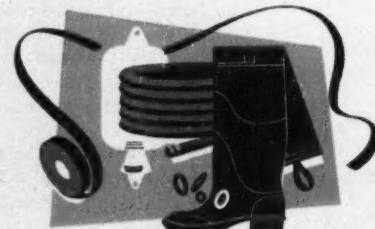
**Ideal for sound deadening, insulation or calking compounds**

Polybutenes are widely used in various insulating compounds by the automotive industry (1) to prevent rust and corrosion of metal chassis parts (2) to prevent rattles and squeaks as a "noise eliminator" between metal to metal surfaces. In the home appliance industry as an insulation compound medium against heat or cold. Compounds can be pigmented or used in natural color of the mineral filler.



**Electrical properties outstanding**

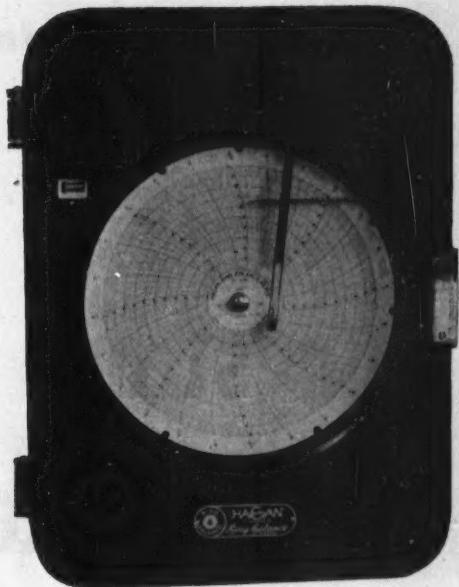
Oronite Polybutenes offer superior dielectric strength, low expansion coefficient and low power factors essential in paper-insulated electrical products. Because of their low power factor values over a wide frequency range, they are useful as a dielectric in condensers and capacitors. Accelerated aging tests show the great stability of this power factor over long periods of time. Their compatibility with many synthetic rubber and rubber-like polymers permits ready compounding for flexible insulations.



**Economical extender of rubber**

Polybutenes can be used as a rubber extender in the manufacture of rubber boots, garden hose, hot water bottles and a host of other molded rubber products. Besides extending rubber, Polybutenes plasticize the mass of rubber making it more pliable for easy milling. Polybutenes are also used in milling up reclaimed rubber batches and have a field of usefulness in plasticizing various synthetic rubber latices.

→ When  
you  
install



## HAGAN RING BALANCE FLOW METERS

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Accuracy  
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Durability  
Versatility

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AERONAUTICAL TESTING LABORATORIES

Hagan Ring Balance Flow Meters give dependable readings over the chart range, and give good response at low flow rates.

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The Hagan Ring Balance Meter is the most versatile meter made. Whatever your metering problems, our engineers will be glad to show you how Hagan Meters can help you solve them.

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STREET AND NUMBER \_\_\_\_\_

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CE-4

**Reduce slag...increase production**

*with the*

# Ljungstrom Air Preheater

**Slag** — primary cause of reduced capacity — can be practically eliminated by the use of a Ljungstrom Air Preheater.

That's because preheated air mixes more thoroughly with the fuel. Therefore, less excess air is required for complete combustion — and less combustible material is lost in the flue gases.

Thus, with a Ljungstrom Air Preheater, there is less material present in the furnace for slag production. Oil tubes stay cleaner . . . longer. Stills stay on stream *at top production* for months longer.

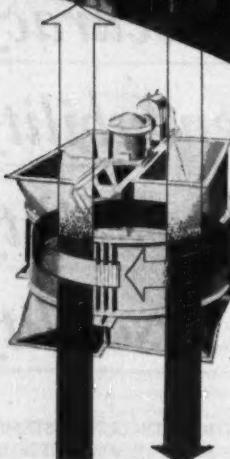
For example, a pipe still in an eastern refinery dropped from 16,000 barrels a day to 12,000 because of slag. Now, with a Ljungstrom Air Preheater and modern high-temperature burners, the still operates continuously *at 18,000/20,000 barrels*.

This saving alone can pay for a Ljungstrom installation in less than a year. Add it to more economical furnace design possible . . . up to 20% fuel savings . . . greater heat recovery even from low grade fuels . . . higher through-put — and you can see why the Ljungstrom Air Preheater is perhaps the most significant guidepost to economy available today to refiners.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits attainable in your fuel burning equipment — call or write The Air Preheater Corporation today.

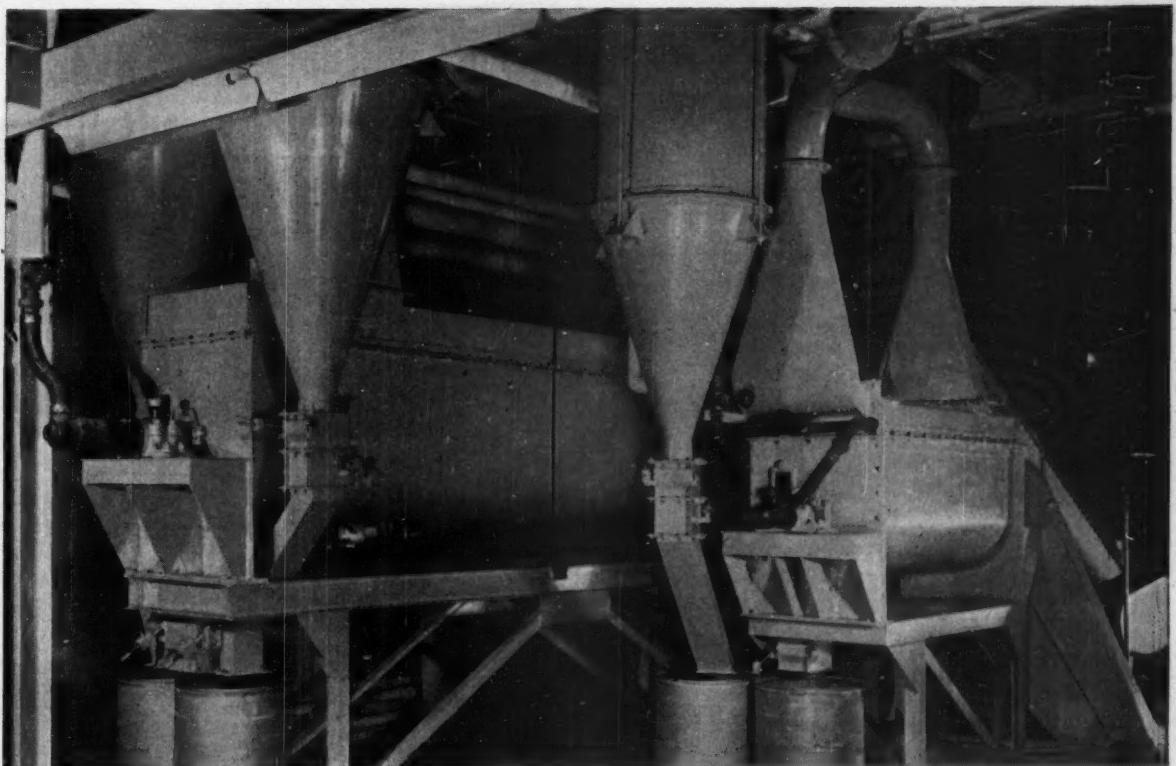
## The Air Preheater Corporation

60 East 42nd Street, New York 17, N. Y.



The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

**WHEREVER YOU BURN FUEL, YOU NEED LJUNGSTROM**



Midwest manufacturer saved enough in six months to pay for this two-unit Monotube installation. Solvents, formerly lost in processing, are recovered by drying.

## Here's double assurance of the correct dryer for your process

### ROTO-LOUVRE



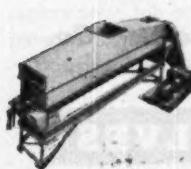
Drum design provides aerated mass drying. Will not damage heat-sensitive materials. Gradual, positive heat transfer prevents case-hardening. Ask for Book 1911-B.

### MULTI-LOUVRE



For rapid treatment of large quantities of material. Uniform, constant agitation promotes efficient, uniform drying with minimum degradation. Ask for Book 2409.

### MONOTUBE DRYER



For small, inexpensive installations. Excellent for fine-particle materials. Minimizes dusting. Equally effective at high or low temperatures. Ask for Book 2413.

## LINK-BELT builds 3 types ..offers free testing service

No single dryer can meet all processing conditions—or dry every kind of material. That's why Link-Belt builds three types of dryers—Roto-Louvre, Multi-Louvre and Monotube. Each has specific advantages . . . provides drying service that matches particular production processes. In addition, we offer a free laboratory analysis of your material. We'll test it by utilizing our laboratory facilities . . . work out procedures that can be duplicated in your plant. Ask for this free service today. Simply send samples of your material, a pound or a ton, or call the nearest Link-Belt office for further details.

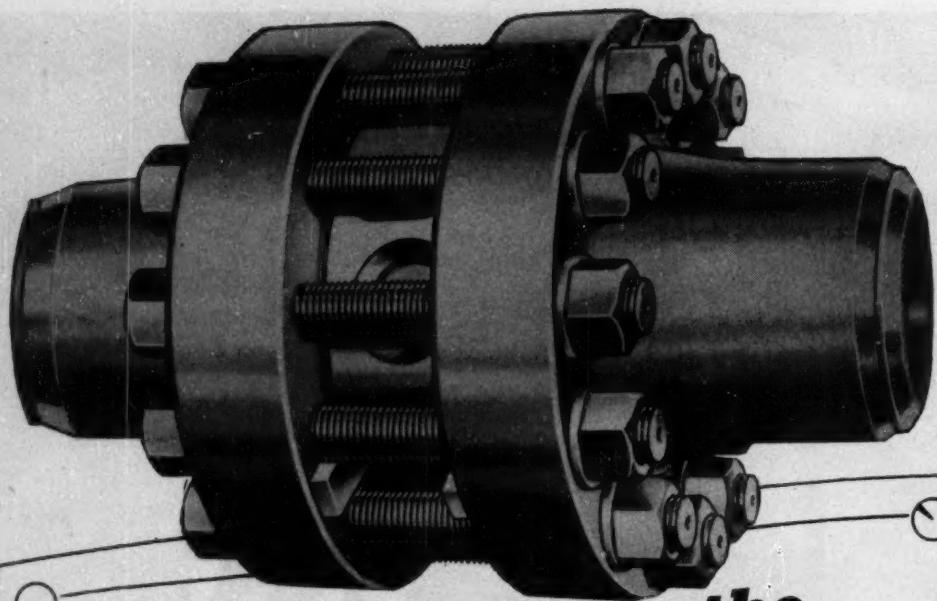
**LINK-BELT**



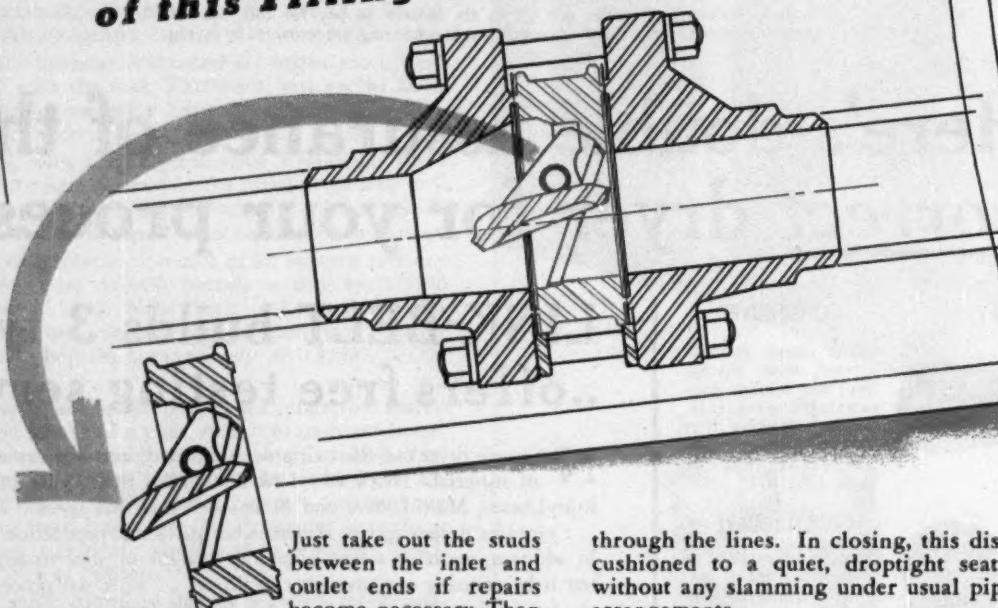
DRYERS • COOLERS • ROASTERS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities.

13-128



**You Can Remove the  
Center Section  
of this Tilting Disc Check Valve**



Just take out the studs between the inlet and outlet ends if repairs become necessary. Then the entire center section can be replaced . . . quickly and easily. No need to cut the valve out of a welded line.

The Tilting Disc Check Valve has the advantage of smooth, easy operation because of the balanced disc, which rides steadily and without fluttering in the flow

through the lines. In closing, this disc is cushioned to a quiet, drop-tight seat . . . without any slamming under usual piping arrangements.

Chapman Tilting Disc Valves are also available in the standard two-piece design, in either iron or steel, for all pressures. Write for full details and prices to

**The Chapman Valve Mfg. Co.**  
INDIAN ORCHARD, MASS.

**CHAPMAN 3-PIECE CHECK VALVES**

**Where fluctuating load  
is the problem...**



## **TYPEE** gearturbines can handle it!

Process requirements in the evaporator room of the Masonite Plant, Ukiah, California, called for a variable-speed pump drive to provide for fluctuating load conditions. Steam was available. In the words of this user: "Westinghouse Type E, Close-coupled Gearturbines were selected since the pumps had to operate at relatively low speeds, and the higher efficiency inherent in the high-speed turbines was desirable. In operating performance, these turbines have proved the most efficient and economical solution to our problem."

Also in the evaporator room, the Masonite Company selected four Westinghouse Type E Turbines to drive the boiler feed pumps. These turbines provide an efficient, trouble-free drive which can be driven by the existing steam supply. Motor-driven units are used as stand-bys.

This use of both types of Westinghouse Turbines is the kind of over-all unit responsibility that actually makes your job of purchasing, installation, and maintenance easier . . . more dependable.

Wrapped up in a single package is a compact, rugged,

and reliable speed-reduction unit solidly coupled to a Type E turbine. Each gearturbine is mounted on an extremely rugged base, fabricated of heavy steel plate which forms the oil reservoir. This arrangement simplifies mounting and installation. It provides operating stability never before available.

Get the full story on the broad Westinghouse turbine line. Book B-4346 clearly explains the applications, refinements and distinct standard features of Westinghouse Gearturbines. Call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-50539

**YOU CAN BE SURE...IF IT'S  
Westinghouse**

**TYPEE** Turbines



# ONLY PICCOLYTE

*can offer you:*

**COLOR**—so light that new color standards were made necessary.

**ECONOMY**—Low in first cost and soluble in low-cost petroleum solvents.

**VARIETY**—Standard and special grades in melting points from 10° C. to 125° C.

**NEUTRALITY**—Low acid number—less than 4—unsaponifiable.

**WATERPROOF**—Piccolyte resins are unaffected by water or moisture.

**PERMANENCE**—Stable and non-yellowing—unaffected by alkalies and salts.

**LOW COST** made by patented process that permits low selling price.

*Write*

—for complete data, specifications and samples. Please describe intended use in inquiry.

Clairton, Pennsylvania

Plants at Clairton, Pa.; West Elizabeth, Pa., and Chester, Pa.

to keep temperatures  
within NEMA\* guarantees



Plan to visit the exhibit of the TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION at the 1953 International Petroleum Exposition located at the East end of the Exposition grounds.

## these Pennsylvania Transformers are cooled with Ross Exchangers

• This bank of three 29,000 Kva, 230,000-volt transformers is typical of many such high voltage power units which Pennsylvania Transformer Company, Canonsburg, Pa. furnishes to major industries and electric utilities.

To prevent transformer oil from reaching excessive temperatures, through heat generated in normal operation, each of these Pennsylvania units is equipped with two Ross Exchangers. Utilizing water as a coolant, their function is to receive the hot oil from the transformer, cool it as required, and return it for its job of maintaining the transformer temperature in accordance with NEMA guarantees.

Why have Pennsylvania's engineers selected Ross Exchangers for

these applications? Among other things: "Ross equipment has many excellent features and the Ross organization has a fine background of manufacturing experience...has been very cooperative with us in connection with our heat exchanger problems."

The desire and competence of Ross engineers to consult in the solution of any heat exchange problem...plus the wide adaptability of Ross fully standardized, pre-engineered designs and sizes, have earned a preference for Ross Exchangers in practically every field of application: engines, compressors, turbines, speed changers, hydraulic machinery and numerous others.

To be familiar with the principal Ross benefits, make sure you have

the latest Ross literature. Request Bulletin 2.1K1 for information on the removable tube bundle Type CP Exchangers used on Pennsylvania Transformers, or Bulletin 1.1K5 on all-copper and copper alloy Type BCF units. Write.

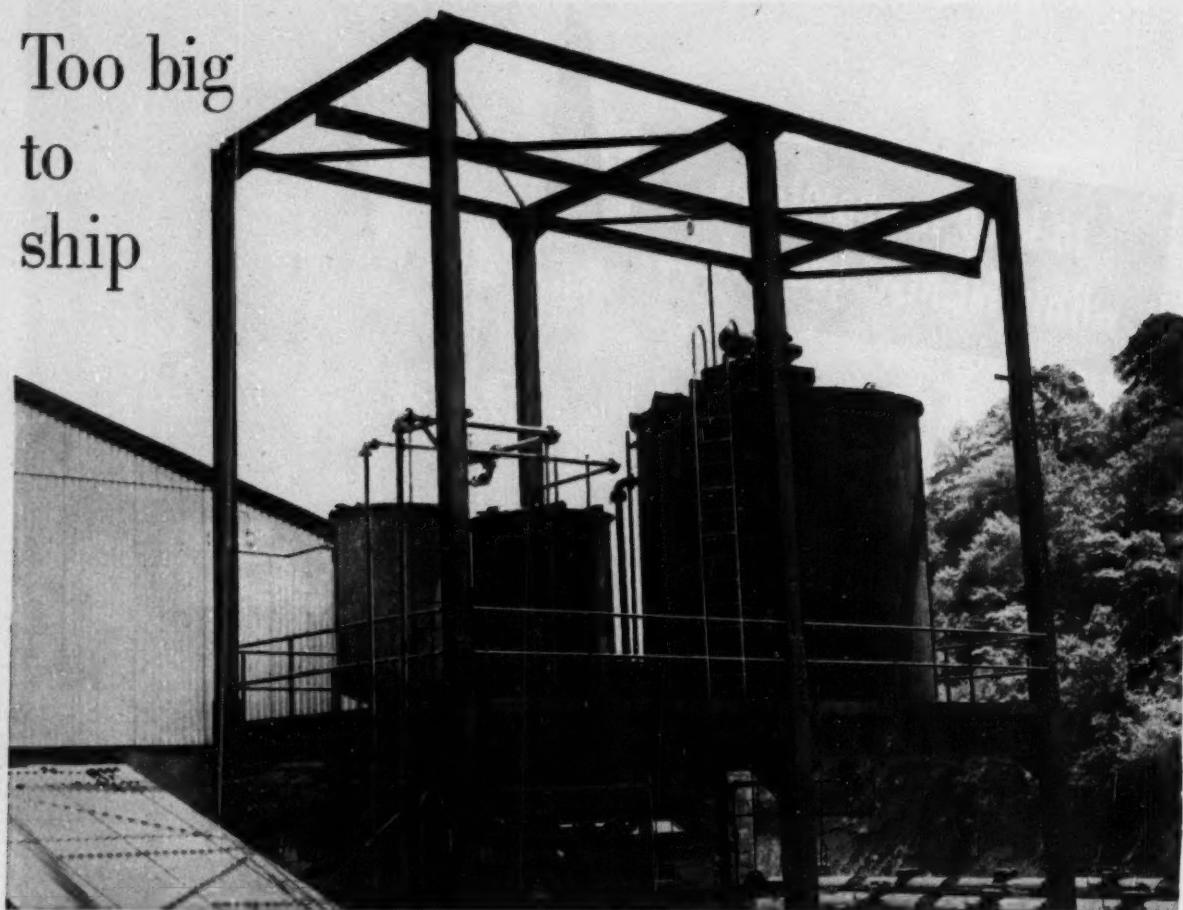
**KEWANEE-ROSS CORPORATION**  
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION  
1411 WEST AVENUE • BUFFALO 13, N. Y.



\*National Electrical Manufacturers Association

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

Too big  
to  
ship



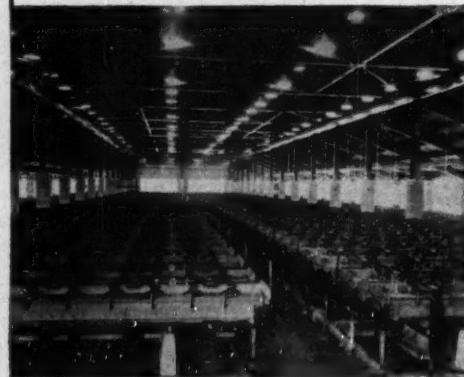
so U.S. Permobond® protective linings were installed on the spot

EQUIPMENT requiring protection against corrosive attack can be lined with Permobond linings—*right in your own plant*. The above storage tanks in a chemical plant, for example, were too big to be shipped. So United States Rubber Company's Permobond Lining was installed and vulcanized right at the job site—insuring complete protection against the corrosive chemicals stored in the tanks.

This is one more example of the versatility and adaptability of the Permobond process. You can also have it installed as *original equipment* on anything that contains or conveys corrosive materials and chemicals—piping, tanks, valves. And where special conditions occur, a wide range of synthetic Permobond lining stocks is available. Write to the address below.



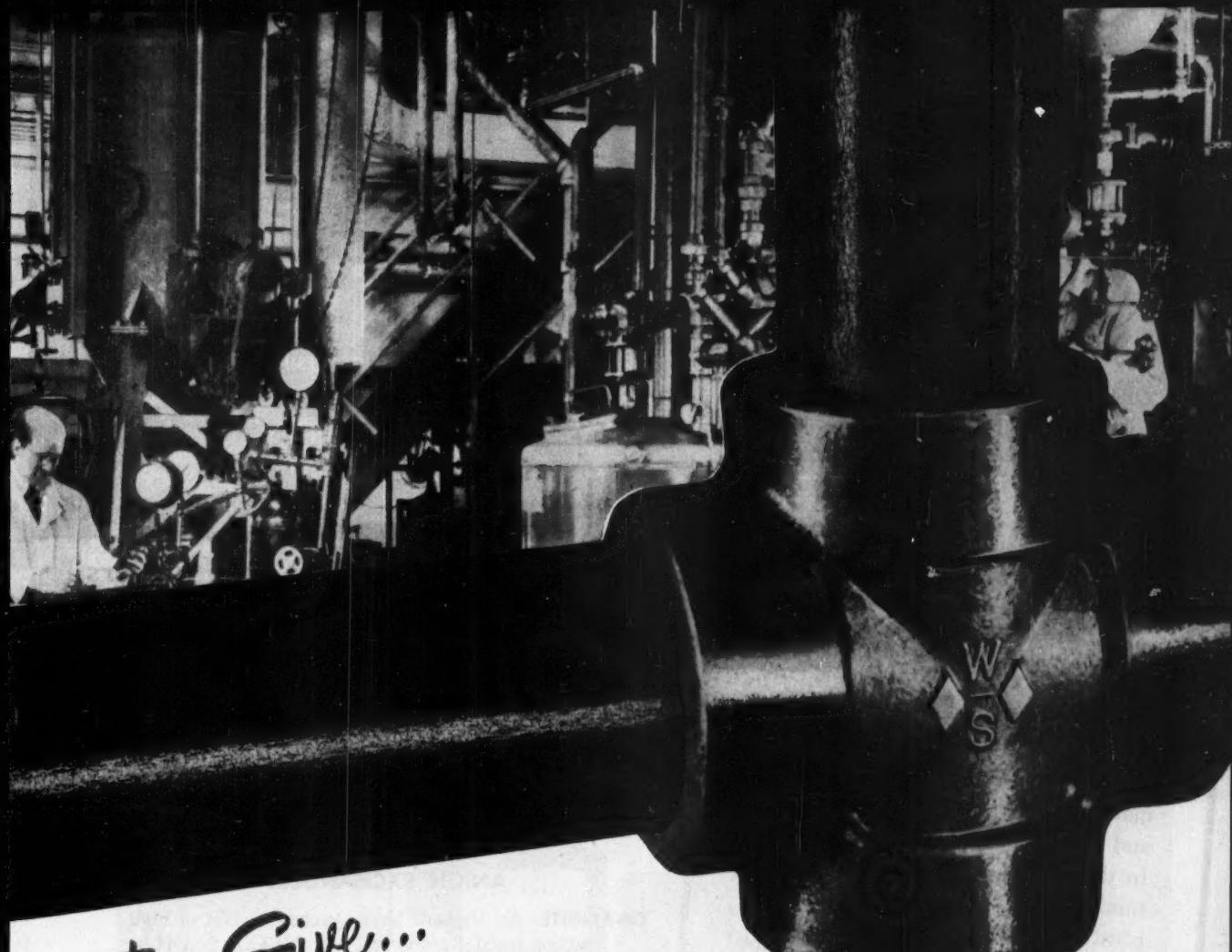
These hundreds of electrolytic mercury cells producing caustic soda and chlorine are lined with specially compounded Permobond hard rubber lining.



"U. S." Research perfects it... "U. S." Production builds it... U. S. Industry depends on it.

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**PERMANENT PIPE-LINE SECURITY**

From *Master Craftsmen* come the world's finest **FITTINGS** . . . drop forged from solid billets of specially blended **STEELS**.

Your pipe connections can be harmonious and lasting . . . even endure beyond the normal life of the system . . . if proper consideration is given the compatibility of their meeting. Many millions of feet of pipe and tubing have been brought together by W-S Double-Diamond Forged Steel Fittings in lasting unions against time . . . heat . . . pressure . . . turbulence . . . corrosion . . . oxidation . . . vibration . . . reduction and shock.

Such fortunate meetings withstand the adverse conditions of *ANY* service environments because W-S FITTINGS are inherently superior to those made by methods other than PRECISION MACHINING from solid FORGED stock.

Whatever your pipe or tubing application, you can profit from the permanence of W-S Double-Diamond (Screw-End and Socket-Weld) Forged Steel Fittings.

**SOLD THROUGH LEADING DISTRIBUTORS**



**WATSON-STILLMAN FITTINGS DIVISION**

**H. K. PORTER COMPANY, INC.**

**130 ALDENE RD., ROSELLE, NEW JERSEY**



# PERMUTIT Q?

CATION EXCHANGE RESIN

**P**ERMUTIT Q is a bead type sulfonated polystyrene synthetic resin cation exchanger with high capacity. It is extremely resistant to wide pH ranges, high temperatures and oxidizing conditions, and may be operated on either the sodium or hydrogen cycle.

Forty years have passed since Permutit manufactured the first ion exchangers and applied them to water conditioning. In those forty years, ion exchange as a fundamental scientific tool has been applied in many different fields—and many new ion exchangers have been developed and manufactured by Permutit to meet specific needs.

Permutit is proud of its leadership in the extremely important field of ion exchange. Permutit Q is only one of many Permutit products. At right, a word about a few of the Permutit ion exchangers—some of which may apply to your own field.

Write today for full information and samples.

## Additional Permutit Ion Exchangers

### CATION EXCHANGERS

**ZEODUR**—A processed glauconite, regenerated with salt.

**DECALSO**—A precipitated gel type sodium aluminosilicate.

**ZEOKARB**—A sulfonated coal, regenerated with either salt or acid.

**PERMUTIT H-70**—A high-capacity carboxylic acid resin.

### ANION EXCHANGERS

**DE-ACIDITE**—An aliphatic amine exchange resin of high reaction speed. Regenerated with  $\text{Na}_2\text{CO}_3$ ,  $\text{NaOH}$  or  $\text{NH}_4\text{OH}$ .

**PERMUTIT A**—A medium strength exchange resin which removes weak acids from solution. Regenerated with  $\text{NaOH}$ .

**PERMUTIT S**—A basic quaternary amine exchange resin. Removes acids as weak as silicic acid from solutions. Regenerated with  $\text{NaOH}$ .

# PERMUTIT

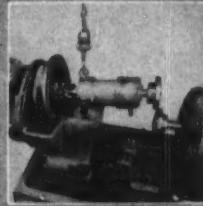
ION EXCHANGE HEADQUARTERS FOR 40 YEARS

**DE LAVAL**  
LIQUOR PUMPS

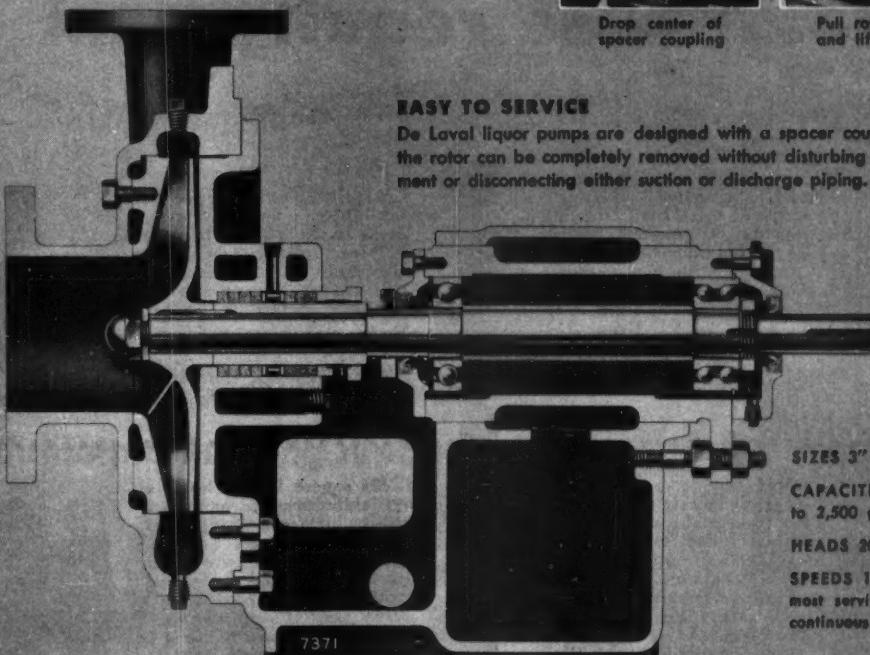
for tough chemical service



Drop center of  
spacer coupling



Pull rotor back  
and lift out



**EASY TO SERVICE**

De Laval liquor pumps are designed with a spacer coupling so that the rotor can be completely removed without disturbing motor alignment or disconnecting either suction or discharge piping.

SIZES 3" to 6"

CAPACITIES 100 gpm  
to 2,500 gpm

HEADS 20' to 150'

SPEEDS 1,150 rpm for  
most services requiring  
continuous operation

- One piece suction nozzle with single joint minimizes leakage.
- Eductor vanes on back of impeller relieve stuffing box pressure.
- Rotor can be adjusted with

- external adjusting screw to compensate for wear.
- Oil mist lubrication minimizes bearing friction.
- Extra deep stuffing box has inlet and outlet water seal con-

- nctions and inlet and outlet stuffing box cooling connections.
- Suction liner is easily and inexpensively renewed.
- Heavy stiff shaft withstands severe operating conditions.

The important design features, shown above, explain why De Laval type CL Liquor Pumps (1) take the punishment of tough chemical service for years; (2) cut maintenance costs.

These pumps are especially designed to handle "tough" corrosive or erosive liquids such as hot or cold

acids, alkalies, digester liquors, milk of lime, etc. What's more, De Laval Liquor Pumps are easy to get at for servicing, thus substantially reduce downtime.

See your De Laval representative for full application and specification data on these De Laval pumps, or write giving details on your specific service.



**DE LAVAL** *Liquor Pumps*

DE LAVAL STEAM TURBINE COMPANY  
803 Nottingham Way, Trenton 2, New Jersey

DL 195

# CMH

## One dependable source for every flexible metal hose requirement

CMH corrugated hose is available with metal braid covering or unbraided in steel, bronze or stainless steel. Used where great flexibility is required at high temperatures and high pressures. Sizes range from  $\frac{1}{4}$ " I.D. to 24" I.D. Depending on size, type and material, it will handle burst pressures to 12,000 psi, temperatures to 1200° F.

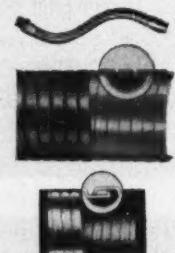
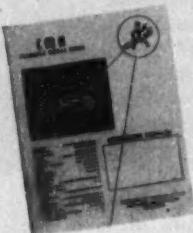
CMH interlocked hose is available in various types, packed and unpacked, in steel, stainless steel, bronze, aluminum, brass and other metals. It is used for steam, exhaust, tar and asphalt, etc. Sizes  $\frac{1}{2}$ " to 12", I.D. Depending on size, type and material, it may be used for working pressures to 750 psi (constant), temperatures to 600° F.

CMH double groove (ball bearing design) hose is available in bronze, steel or stainless steel with asbestos packing and with or without metal braid covering. Widely used for non-searching liquids and gases at low to moderate pressures and temperatures. Sizes range from  $\frac{1}{4}$ " to  $1\frac{1}{4}$ ", I.D.

CMH square locked hose is available unpacked or with a choice of several types of packing in steel, bronze, brass, aluminum, stainless steel, etc. It is used as conduit, cable armor, nozzles and many similar applications. Sizes range from  $\frac{1}{4}$ " to 1", I.D. Normally used only at very low pressures.

For full information on all CMH hose products write for Catalog 130 or see the Flexonics catalogs in Sweet's Plant Engineering File, Chemical Engineering Catalog and The Refinery Catalog. For maintenance hose, see the classified pages of your telephone directory for the name of your CMH distributor.

Standard assemblies and special purpose flexible metal hose items are manufactured for such services as steam, tar and asphalt, machine tool coolants, machine tool wiring conduit, dry granular products. We will be pleased to send data on any specific requirement.

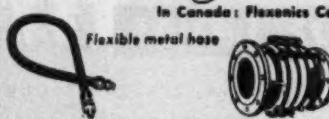


Flexon identifies  
CMH products that  
have served industry  
for over 50 years.

### CHICAGO METAL HOSE Division

Flexonics Corporation

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario



Flexible metal hose

Expansion joints



Aircraft components



Metallic bellows  
and  
bellows assemblies





California Refining reports

# FOAMGLAS®

ideal because it STAYS DRY

For the manufacture of high octane blending components, the California Refining Division of The California Oil Company, Barber, New Jersey *must* maintain constant operating temperatures, ranging from 30°F. to 60°F., in its outdoor alkylation equipment and piping. To solve this problem California Refining turned to FOAMGLAS. They report "FOAMGLAS has proved ideal for our needs because it *stays dry*, will not absorb spillage. And its sealed glass cells guarantee the constant operating temperatures we require *plus* giving us the added benefit of incombustibility and trouble-free, long life."

You, too, can obtain added values by using FOAMGLAS. Consider its *plus* features . . . stays dry! . . . fire and acid proof . . . can not rot . . . rigid structure and high compressive strength . . . outstanding durability. Let FOAMGLAS help to solve your insulating problems!

Outdoor equipment and piping of Alkylation Unit at California Refining Division. Reactor, drum, exchanger, and miscellaneous piping insulated with FOAMGLAS.

Engineer:  
M. W. Kellogg Co.,  
Jersey City, New Jersey



Pittsburgh Corning Corp., Dept. H-43  
Pittsburgh 22, Pa.

Please send me free sample and booklet on use of Foamglas for:

- Steam Lines
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Company \_\_\_\_\_

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PITTSBURGH 22, PA.

# PROCESSING IS MORE EFFICIENT TODAY

That reason is the Banbury\* mixer—the machine you see in so many modern, up-to-the-minute processing layouts. And the reason why you see the Banbury so often is because its design has never been allowed to grow old.

Methods of installing Banbury mixers have been developed which make it possible practically to eliminate the manual handling of stock to and from auxiliary equipment. Improvements in operating techniques and in the design of the machine itself have made the production of successive batches more and more uniform. With the addition of control equipment, such as a timing device, temperature recorder and discharge mechanism, each operation in the mixing procedure can be accurately controlled and an even flow of production assured.

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BANBURY MIXERS ARE USED FOR THE FOLLOWING PRODUCTS: Automotive Tires and Tubes • Rubber Shoes • Rubber Soles and Heels • Mechanical Rubber Goods • Foam or Sponge Rubber • Insulated Wire • Rubberized Cloth Druggists' Sundries • Hard Rubber Articles • Battery Cases, Rubber and Asphalt • Asphaltic Materials • Asphalt Tile • Rubber Tile • Devulcanizing and Reclaiming • Gutta Percha • Floor Coverings • Matting • Linoleum • Roofing Material • Sound Records • Resinous Compounds • Phenolic Condensation Products • Pyroxylin Plastics • Vinyl Chloride Plastics • Plastic Film • Cellulose Materials • Paints, Enamels, Varnishes, Lacquers • and many other compounds.

\*Trade-mark

FB-689

## Security for Sensitive Chemicals-

# in Hackney Stainless Steel Drums

REMOVABLE HEAD OR TIGHT HEAD

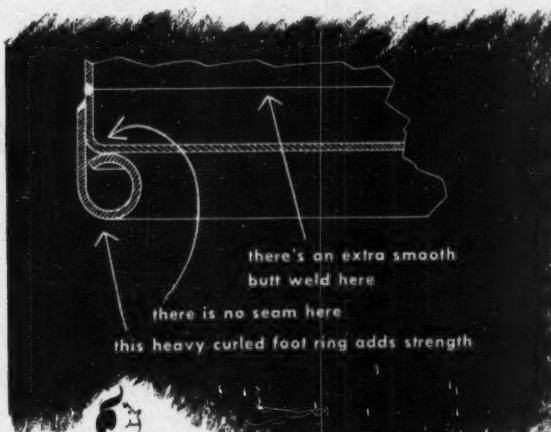


Ship with safety in these Hackney Stainless Steel Drums. They're rugged and lightweight—assure complete protection for your products in transit or in storage.

**Protection from Corrosion and Discoloration—**Available in several types of stainless steel to suit product requirements. Also in nickel and monel metal.

**Protection from Contamination—**Drums easily and quickly cleaned for re-use—smooth interiors have no cracks or crevices where traces of the previous shipment can lodge.

**Protection from damage in transit—**Designed to take the hard knocks of shipping without danger of leakage. Heavy I-bar rolling hoops securely attached. Heavy curled foot rings for added protection. Good for years of service and many, many round trips.



HERE'S THE SMOOTH HACKNEY  
CHIME CONSTRUCTION—

### Other Hackney Features that Assure Full Protection and Low Maintenance—

**Removable Head Drums:** Steel reinforcing ring in top curl for extra strength. Cover extends over top rim to keep out dirt when drum is opened.

Your choice of quick-acting Togglelite or bolt type closure. Furnished with or without rolling hoops, in 30, 50 or 55 gallon sizes.

**Tight Head Drums:** Full curled foot ring on both ends. Forged steel spuds, securely welded and protected by the rolling hoops.

Seamless heads attached by smooth butt weld—that leaves no crevice—assures easy cleaning.

Complete specifications are given in the new Hackney Drum and Barrel Catalog. Write today.

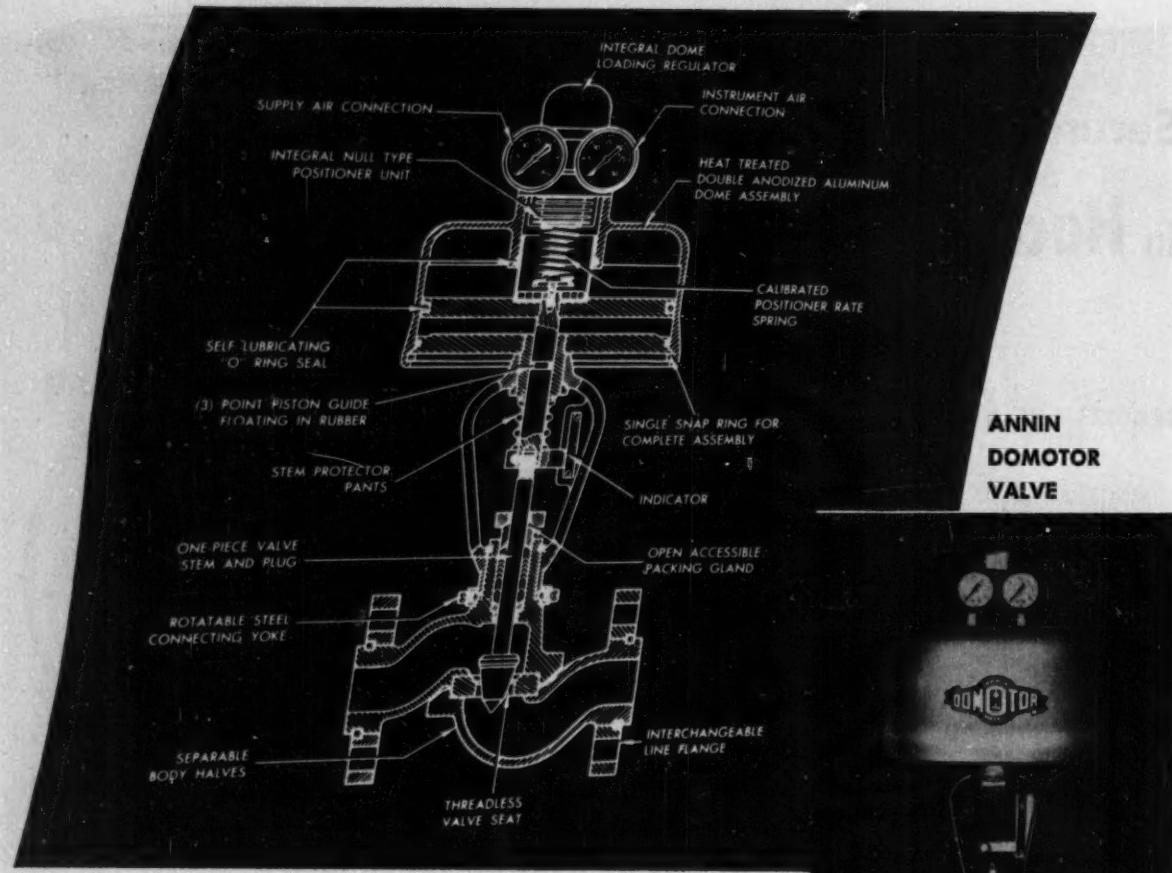
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Manufacturer of Hackney Products

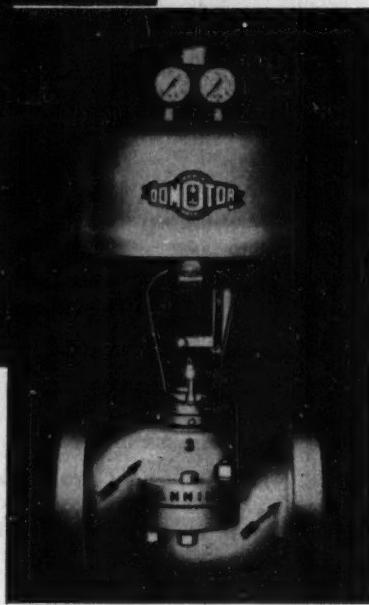
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When precise control of hard-to-handle fluids is required, engineers and production men have learned from experience to depend on Annin Valves. Designed for long life, low maintenance, and efficient operation, Annin Valves are widely used to control erosive and corrosive fluids under a wide range of temperatures and pressures. Interchangeability of valve bodies, flanges, operators, and plug assemblies lowers the initial investment and cuts inventory requirements.

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showing how and why  
Annin offers the best  
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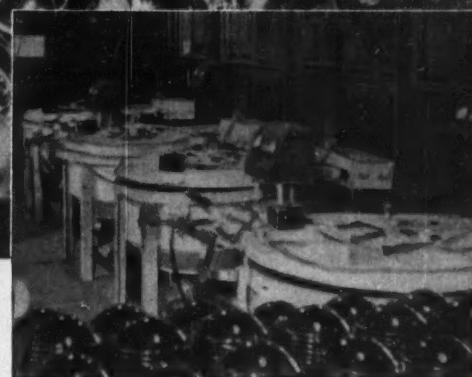
# VACUUM METALLIZING...

"More and more use is going to be made of this remarkable process", said exhibitors at the 1952 Metal Show.

"Working in a DRY atmosphere greatly speeds up pulling the vacuum", reports Canadian Motor Lamp Company.

**THE PROCESS:** Metal or plastic parts are placed in a sealed retort. A high vacuum is pulled and aluminum wire is vaporized by an electric current. This deposits on the parts, giving 85% reflective power, compared to 62% for polished aluminum.

**THE PROBLEM:** Moisture in the air and on the parts being metal coated slows down the pulling of a vacuum, cutting production and increasing costs.



**THE SOLUTION:** DRY the air with a Lectrodryer® as Canadian Motor Lamp Co., Ltd. do at their Windsor, Ont., plant. They report that it would be impossible to maintain their high production schedule and turn out such quality workmanship without this DRYing help.

Names of companies making equipment for this high vacuum coating of metals and plastics will be supplied to you on request. Where DRYing is indicated for the air surrounding this equipment, or for air supplied to their retorts,

Lectrodryer will work with them to give you most efficient, economical operation.

For further information, write to Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Penna.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.  
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.  
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY  
WITH ACTIVATED ALUMINAS

# LECTRODRYER

\* REGISTERED TRADEMARK U. S. PAT. OFF.

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GET YOUR VACUUM  
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**ELLIOTT**  
*Steam Jet*  
**EJECTORS**

If it's low vacuum, with intermittent service, a small priming ejector, may do the job. If it's extremely high vacuum, constantly maintained, a multi-stage installation of large ejectors, complete with intercondensers, may be called for. In short, Elliott ejectors — and the "know-how" that goes with them—cover the entire range of commercially obtainable vacuum, including such conditions as the handling of highly corrosive vapors.

Elliott Company's position in the field of vacuum equipment and its application has been a development of years. The resultant valuable experience is at your service with no obligation. To apply it, contact your local Elliott representative, or write Elliott Company, Jeannette, Pa.

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bulletins covering the entire ejector range. Tell us your requirements.



**ELLIOTT Company**  
**INDUSTRIAL PROCESS DIVISION**

G3-2

# DIETHYL MALONATE IS BASIC FOR BARBITURATES

A member of the large DOW family of chemical intermediates,  
 DIETHYL MALONATE has proved valuable in the synthesis  
 of pharmaceuticals and other chemicals



## properties a colorless liquid

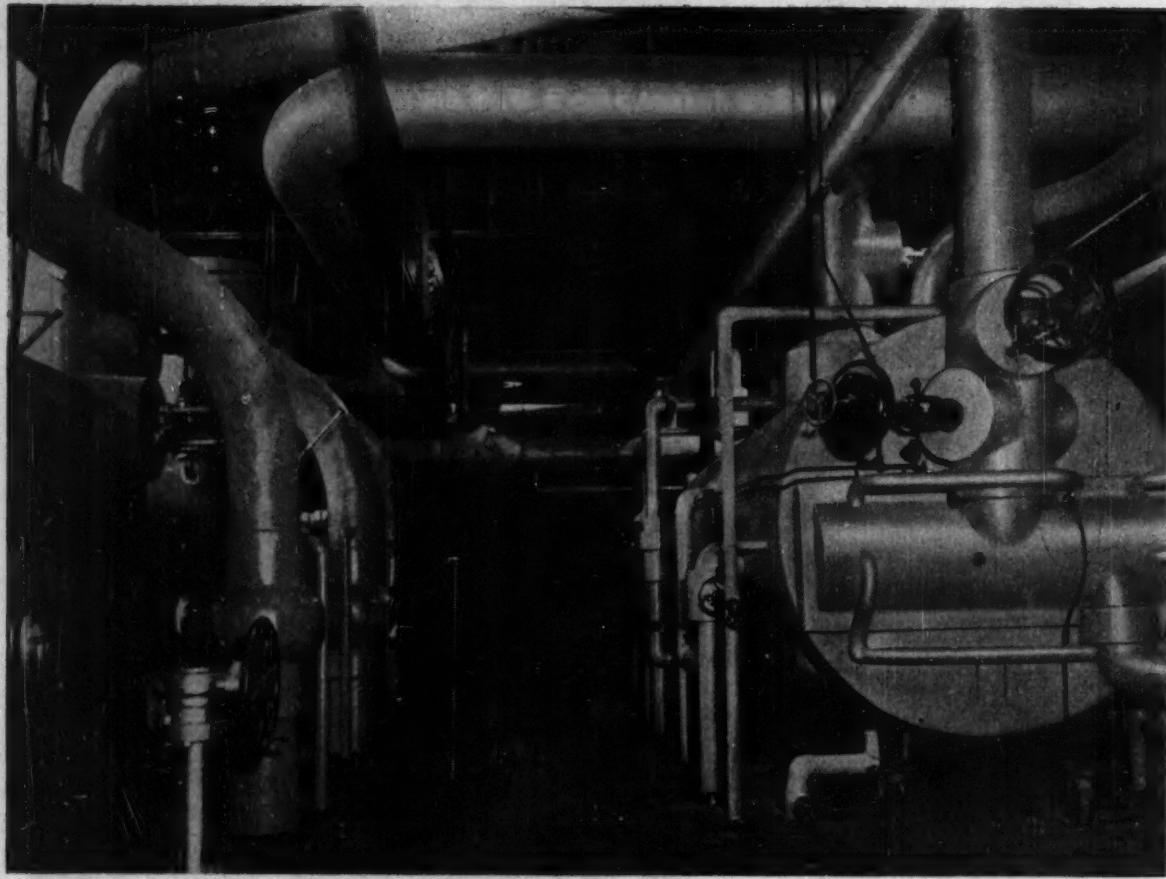
Boiling range at 760 mm. Hg, 5-95%	196-200° C.
Specific gravity at 25/25° C.....	1.055
Freezing point.....	Below-20° C.
Refractive index at 25° C.....	1.412
Flash point.....	200° F.
Fire point.....	205° F.

In the pharmaceutical industry, Dow diethyl malonate is valued as an intermediate for the manufacture of barbiturates. In other fields, diethyl malonate finds wide use as an excellent "building block" in the synthesis of many chemical intermediates and organic pigments . . . offers many possibilities, too, for your research and production.

For assured quality and uniformity of the chemical intermediates you use, depend on Dow's many years of research and experience, combined with its broad production facilities. If you have not received your free sample of diethyl malonate, write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. FC 3-7.

*you can depend on DOW CHEMICALS*





Scene in large southern power station. Main steam line and feeder equipment insulated with K&M Hy-Temp and "Featherweight" 85% Magnesia, in combination

## Save heat—Save dollars with K & M high-temperature insulations

For applications up to 1900°F., the combination to keep in mind is that of K&M Hy-Temp Insulation and "Featherweight" 85% Magnesia.

Two separate layers of insulation with vertical and horizontal staggered joints eliminate heat loss which occurs when expansion of hot piping and equipment causes joints to open in single layer installations. K&M Hy-Temp Insulation (diatomaceous silica), effective up to 1900°F. is applied directly to the

hot surfaces and "Featherweight" 85% Magnesia Insulation (85% basic carbonate of Magnesia and asbestos fiber), effective up to 600°F. forms the second layer.

This effective K&M combination will last the life of the equipment it serves —will withstand moisture, vibration, alternate heating and cooling, wetting and drying. Both materials are supplied in all appropriate forms and thicknesses.

*Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.*

Nature made Asbestos . . .  
Keasbey & Mattison has made it  
serve mankind since 1873

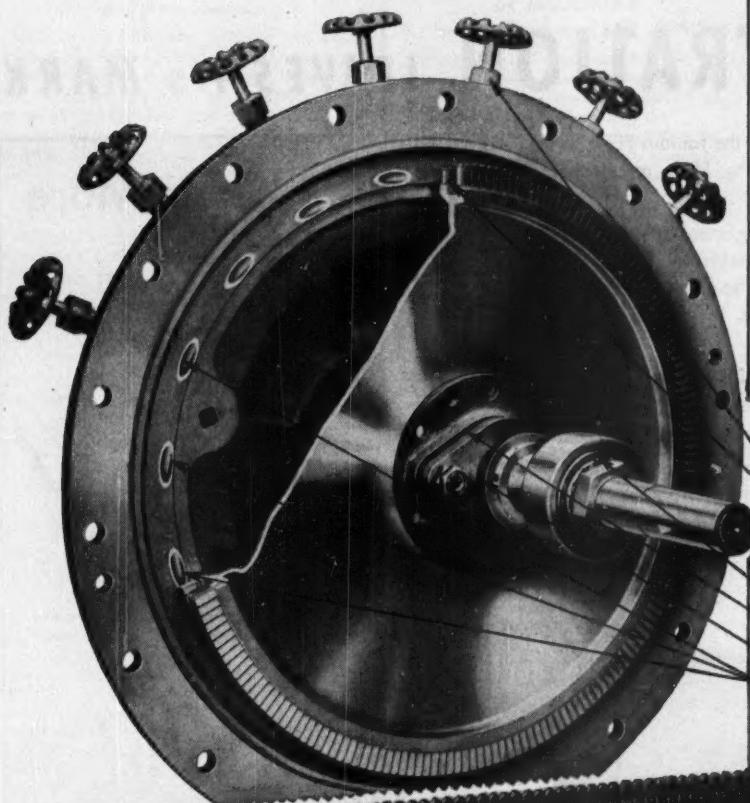
**KEASBEY & MATTISON**  
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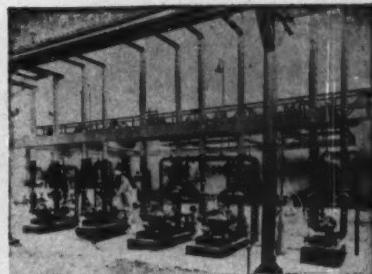
# No other steam turbine offers you

## SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



**COPPUS "BLUE RIBBON" TURBINES**



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemical Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

### MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

#### WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP.,  
224 Park Avenue, Worcester 2, Mass.  
Sales offices in THOMAS' REGISTER.

7 hand valves for efficient partial load operation,  
(20" turbine shown)

2 row velocity-stage turbine wheel with stainless  
steel turbine buckets — statically and dynamically  
balanced

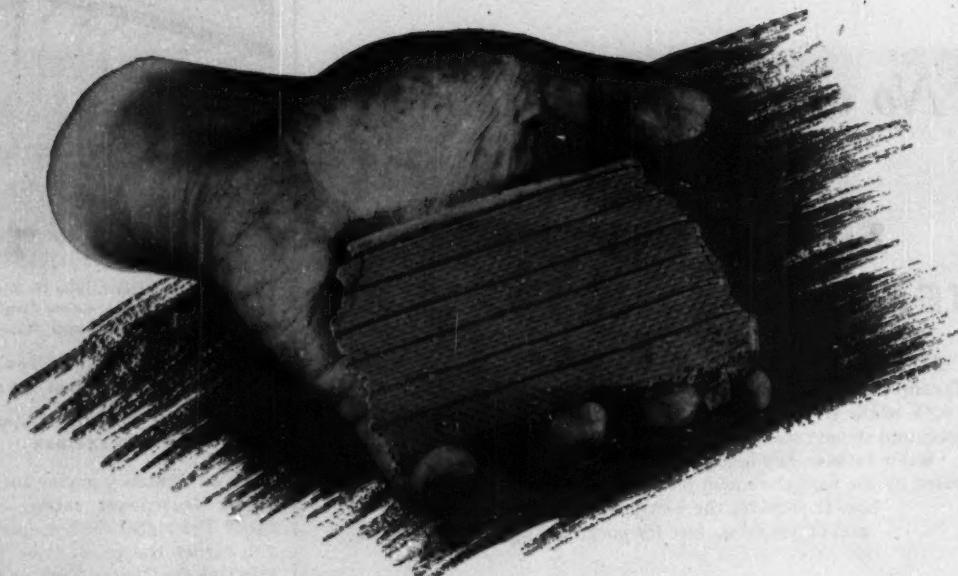
30-40 carbon steel shaft

Oversized double row deep grooved ball bearing

Stuffing box with metallic packing ring

Heavy chrome plating of shaft through stuffing box

3 nozzles always open



## BETTER FILTRATION LEAVES its MARK

The grooves on this filter cake were made by the famous FEinc String Discharge . . . one of the big reasons why FEinc means better filtration.

The String Discharge literally *lifts* the cake right out of the weave of the filter cloth . . . carries it away in an unbroken sheet. There's no scraper to wear, smear, blind, or plug the cloth. Because compressed air is not needed to free the cake, there's no chance of blowing filtrate back into the cake.

Other FEinc features like the Compression Dewatering Mechanism or the Washing Mechanism give even cleaner cake, and better recovery of solubles.

One FEinc user saved enough with these special high-performance features to pay for his filter in three months. Another replaced four plate and frame presses with one FEinc, and reduced filtration costs 59%. Another eliminated an entire extra drying process by using more efficient FEinc filters. You can save too . . . write us today.

### BETTER FABRICS, TOO!



Our Filtration Fabrics Division is one of the leading manufacturers of long-lasting, synthetic filter fabrics. Send for free sample folder . . . today!

### How to Learn More About FEinc For Your Process

#### 1 FREE TESTING SERVICE

At no expense to you, we'll test your slurry and send you a complete report on what FEinc filters can do for you. In your plant, without interrupting your process, or in our laboratory, with a 5-gallon sample of your slurry. Send it today!

#### 2 PILOT PLANT FILTER



RENT this small but complete rotary filter. Has all FEinc features, plus interchangeable scraper discharge. No capital investment is required, and a generous part of the low monthly rental can be credited against the future purchase of any FEinc filter. Write today for details.



**FILTRATION ENGINEERS INC.**  
155 ORATON STREET • NEWARK 4, NEW JERSEY

# U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

## U.S.I. Announces Booklet On High Surface Sodium

High Surface Sodium—an important new development in industrial use of metallic sodium—is the subject of a new booklet now available from U.S.I.

National Distillers Chemical, the division producing metallic sodium sold by U.S.I., has developed simple techniques for depositing colloidal films of sodium on inert, high surface area solids such as salt, soda ash, carbon, alumina, and sand. The resulting sodium-coated particles are free-flowing, and, since the sodium has a high surface-to-weight ratio, it is immediately available for reaction.

### Provides Many Advantages

Used in this form, the complete and rapid reaction of sodium provides such advantages as easier reaction control, adaptation to continuous operation, dry-way reactions, safe operating procedures, and high yield. Research indicates that High Surface Sodium is useful in reducing metal salts and oxides to finely divided metals; in purifying gases, hydrocarbons and ethers; for preparing sodium hydride and sodamide for use *in situ*; and as a catalyst for hydrocarbon cracking, polymerizations, and rearrangement reactions.

National Distillers Chemical does not produce High Surface Sodium. However, technical assistance on the preparation and use of this form of sodium is available on request from U.S.I., as is the above booklet which covers the development of the process.

## U.S.I.'s Ink Resin Research Continues to Pace Advances in High-Speed Printing Methods

Recent Developments Include New Phthalic, Non-Phthalic Alkyds; Hard Resins for Heat Dry Inks and Rotogravure; Others for Gloss Varnishes for Mixing, Overprinting, and Quick Set Inks

U.S.I.'s Printing Ink Resin Department recently reported a number of new developments which emphasize the company's continuing research program aimed at producing more and better resins for specific printing ink uses. Modern, high-speed printing processes are undergoing constant changes and improvements. As a result, there is a steady need for ink resins

### IN MEMORIAM Seton Porter, 1882-1953

Funeral services were held February 9th for Seton Porter, founder and Chairman of the Board of National Distillers Products Corporation.

Mr. Porter was a graduate of Yale University and subsequently was associated with the engineering firm, Sanderson & Porter. In 1924, he helped to found the National Distillers Products Corporation, serving as its first President until 1949 when he became Chairman of the Board.

His knowledge of industrial engineering and modern business methods contributed much to the progress of chemical, aviation, and motion picture concerns, and his loss will be keenly felt by all who were associated with him.



Research such as U.S.I.'s, leading to more and better resins, helps provide the printing industry with the special inks required by today's high-speed, precision methods.

with special improved properties to allow ink makers to keep in step with the numerous advances in the art of printing. To this end, U.S.I. has for years maintained an active research program devoted entirely to the printing industry's requirements. U.S.I.'s ink resin line now covers almost every present-day printing need.

### New Arochem 533 Resin

One of the company's recent developments is its new, improved Arochem 533—a hard resin for gloss mixing and overprint varnishes. It is easily soluble in 400° F. cooks in most oils, and it is equally useful in 585° F. cooks

MORE ➤

## Uses for Curbay Products Seen Increasing

### Molasses Stillage Products Derived from Alcohol Fermentations Useful as Foundry Binders, Coal Conditioners, Fermentation Aids

Industrial use of U.S.I.'s Curbay products—Curbay Binder, Curbay X, and Special Liquid Curbay—is on the increase, it was reported recently. Manufactured exclusively by U.S.I., these products are concentrated forms of molasses stillage obtained from alcohol fermentations. Industry has found them increasingly useful as binders for such materials as foundry cores, molds, briquetting compositions, case hardening compounds and abrasive compositions. Curbay X is a dried powder which contributes to improved efficiency of coal combustion, according to the report.

### Foundry Aid

In foundry practice, the outstanding advantages of these products, as compared with such materials as molasses, are excellent mixing properties, non-fermenting characteristics, and economy. Special Liquid Curbay can be used very satisfactorily for spraying molds or cores to increase surface hardness, it is said, and Curbay X (Curbay Binder in dry form) can be used in sands for either air-dried or oven-dried cores and molds. Either of these products may also be used as a partial substitute for core oil in quantities depending on individual conditions.

### Combustion Aid

Because of their reported catalytic action and favorable effects on coking properties, Curbay products can be used along with other materials to upgrade inferior type coals and to improve the condition of clinkers and ashes. Curbay products, when used along with other binders, are very desirable ingredients for specially formulated coal briquettes.

### Fermentation Aid

Because of stimulatory effects of Curbay products in promoting microbial growth, they are finding large scale usage in composting and special antibiotic fermentations.

### Special Uses

Due to the presence of natural gums from the original cane molasses, these products are useful in the manufacture of specialties wherein small additions improve colloidal dispersions in emulsions, cements, flotation agents, catalysts, carriers, etc.

Further information on industrial uses of Curbay products may be obtained by writing U.S. Industrial Chemicals Co., Division of National Distillers Products Corporation, 120 Broadway, New York 5, N. Y.

## New Painting Guide Offered

A quick reference index and guide to painting problems encountered in industry is now available in the form of a four-page folder, according to a recent announcement. Such maintenance problems as painting of metal for rust control, painting without odor, protection of concrete, and protection against chemicals and corrosion are covered.

# U.S.I. CHEMICAL NEWS

CONTINUED

## New Printing Ink Resins

to body oils. Its outstanding properties include high viscosity as dissolved, pale color, good drying, and scuff and scratch resistance with gloss.

Both this resin and Arochem 605 are suited for gloss oleoresinous varnishes and quick set ink varnishes made soluble by a small amount of strong solvent, drying oil, or U.S.I.'s Aroplaz printing ink alkyds. These two resins can be used with Arochem 534 or Arochem 359 as solubilizing resins. Gloss varnishes and quick set varnishes made with the above materials can be printed by letterpress or by lithographic processes.

### Aroplaz 1271 Series Extended

Another recent development is the extension of the 1271 series of U.S.I.'s Aroplaz alkyds to make these resins available in a wider range of printing ink varnish bodies. Aroplaz alkyds are long oil, phthalic alkyds, designed for use alone or in combinations as vehicles particularly well suited to letterpress and litho uses. They can now be obtained in litho body numbers which include 00, 0, 1, 3, 5-6, and 8, all with 100 per cent solids content. Other U.S.I. alkyds are available in 100 per cent solids content of plastic body, and can be made in solutions of 70 to 90 per cent solids, dilutable with printing ink high boiling solvents.

Other recent developments in U.S.I.'s line of ink resins include new non-phthalic alkyds of litho varnish bodies including numbers 0, 1, 3, and 6, and an intaglio steel plate varnish alkyd, No. 00 body, which has good grinding, wiping, and drying properties for wet or dry paper.

## Bromine Safety Outlined

Safety measures and regulations which should be followed in handling, storing, shipping and disposing of bromine are detailed in a new safety booklet. First aid measures and medical procedures in emergencies are included.

## Find 'Serenades' Improve Many Chemical Reactions

"Sonochemistry", the science that deals with the chemical effects of sound waves, may one day furnish the means for homogenizing milk, sterilizing water supplies, and even doing the family laundry, all with sound, a meeting of chemists was told recently. Ultrasonic waves, it was explained, can be used to change various materials both chemically and physically. Examples of chemical reactions which can be induced include the formation of hydrogen peroxide from water containing dissolved oxygen, the formation of chlorine gas from carbon tetrachloride, and modification of chemical properties of plastics. Physical changes so far obtained with high intensity waves include the homogenization of milk, the mixing of paints, and even the suspension of mercury in water and oil, it was said. Laundering and sterilizing procedures are also possibilities.

## New Surfactant for Paints Speeds Mixing of Pigments

A non-ionic surface active agent recently introduced on the market can save up to 50 per cent in time required to mix and disperse pigments in paints, enamels, printing inks, putty and caulking compounds, it is claimed. The product is an amber colored, free-flowing liquid which is soluble or miscible in most vehicles and thinners, including raw, bodied and blown oils, petroleum, aromatic, ester, and ketone type solvents, and phenolic, maleic and penta type varnishes and alkyds. When used in paints, it is said to retard hard settling, to control sagging and running, and to overcome silking and flooding. Because of the more thorough wetting and better dispersion that it provides, it tends to intensify and develop color strength and to increase the gloss of films. The agent does not affect the viscosity or drying time of the finished product, and tests indicate it has no effect on the weathering characteristics of paint films, according to the manufacturer's announcement.

## TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U. S. I.

To impart "glass-like" hardness to paint films, a new zirconium-based drier is available which is also claimed to improve gloss, reduce hazing, and to increase film adhesion without embrittlement. (No. 900)

An unusually tear-resistant base fabric for lightweight waterproof goods is woven of flat, ribbon-like continuous multifilament yarns and can be combined with coatings of plastic and natural or synthetic rubber, the manufacturer states. (No. 901)

Push-button shoe soles are now available in the form of foam packaged in pressure cans. User turns the can upside down, releases a small mound of foam on the shoe, then buffs to a high polish. (No. 902)

New fluorescent chalks for lecture and classroom use are available in 5 brilliant colors, can be activated by black or blue light to add a new dimension for vivid color effects, according to the maker. (No. 903)

Rare wood grains and marbles are now reproduced in natural color on thin plastic film for application as veneer to wood, glass, metal, plastic, plaster, or composition. When dry, films can be varnished or waxed. (No. 904)

A sliding lubricant for windows, drawers, other wood and metal moving parts, is said to eliminate squeaking, to resist rust, corrosion, and wear, and to reduce friction. (No. 905)

Areas and volumes can be measured as easily as lengths, it is claimed, with a plastic template for scale drawings which performs basic functions of a slide rule; has no moving parts, and measures cylinders and circles as well as rectangles. (No. 906)

To bend vinyl plastics to themselves, and to wood, metal, glass, acrylic plastics, cloth, and many other materials, new adhesives are available which are claimed to require no heat or pressure, to penetrate surfaces quickly, and to have very fast initial tack or bond. (No. 907)

Chlorine concentrations of solutions can be determined on the spot with new tablets which, when dissolved in water, develop different colors with different strengths of chlorine. (No. 908)

Radiant heating panels of conductive rubber, for attachment to ceilings like wallpaper, are now available for supplementing heat in attics, garages, etc., or for adding radiant heat to a new room. (No. 909)

## PRODUCTS OF U.S.I.

### ALCOHOLS

Amyl Alcohol (Isomyl Alcohol)  
Butanol (Normal-Butyl Alcohol)  
Fuel Oil—Refined  
Propanol (Normal-Propyl Alcohol)

Ethanol (Ethyl Alcohol)  
Specialty Denatured—all regular and anhydrous formulas  
Completely Denatured—all regular and anhydrous formulas  
Pure—190 proof U.S.P.  
"Absolute"—200 Proof  
Solox®—proprietary solvent—regular and anhydrous

**ANTI-FREEZE**  
Super Pyre® Anti-Freeze  
U.S.I. Permanent Anti-Freeze

**ETHERS**  
Ethyl Ether, U.S.P.  
Ethyl Ether, Absolute—A.C.S.

**ACETONE—A.C.S.**

### ANSOLS

Ansol® M  
Ansol® FR

### ACETIC ESTERS

Amyl Acetate—Commercial and High Test  
Butyl Acetate  
Ethyl Acetate—all grades  
Normal-Propyl Acetate

### OXALIC ESTERS

Diethyl Oxalate  
Diethyl Oxalate

### PHthalic ESTERS

Dimethyl Phthalate  
Diethyl Phthalate  
Diethyl Phthalate

### OTHER ESTERS

Diol®  
Diethyl Carbonate  
Ethyl Chloroformate

### RESINS (Synthetic and Natural)

Arochem®—modified types  
Arodure®—urea-formaldehyde resins  
Arofene®—pure phenolics  
Aroflat®—for special flat finishes  
Aroflint®—room temperature curing phenolic  
Aroplaz®—alkyds and allied materials  
Aropel®—copolymer modified alkyds  
Ester Gums—all types  
Natural Resins—all standard grades

### INSECTICIDE MATERIALS

Aliphatic  
CPR Concentrates: Liquid & Dust  
Fiperonyl Butoxide  
Fiperonyl Cyclonene  
Pyrezone® Concentrates: Liquid & Dust  
Pyrethrum Products: Liquid and Dust  
Rotenone Products: Liquid and Dust

### INSECTIFUGE MATERIALS

Indalone®  
Triple-Mix Repellents

### INTERMEDIATES

Acetacetanilide  
Acetoacetyl-ortho-chloroanilide  
Acetoacetyl-ortho-toluidide  
Acetoacetyl-p-phenylbenzoate  
Ethyl Acetoacetate  
Ethyl Benzoylacetate  
Ethyl Sodium Oxaloacetate

### FEED PRODUCTS

Calcium Pantothenate (Feed Grade)  
Curby B-G®  
DL-Methionine (Feed Grade)  
Inositol, U.S.P.  
Riboflavin Concentrates  
Special Liquid Curby®  
U.S.I. Vitamin B<sub>2</sub> and Antibiotic Food Supplements  
Vitaminene® 40

### OTHER PRODUCTS

Acetaldehyde  
Caustic Soda  
Ethylene  
IPC (Isopropyl-N-Phenyl Carbamate)  
CIPC  
Liquid Chlorine  
Metallic Sodium  
Methionine (Pharm.)  
Nitrocellulose Soaps  
Propionaldehyde  
Propionic Acid  
Sulfuric Acid  
Urethane, U.S.P.  
\*Reg. U.S. Pat. Off.

# U.S. INDUSTRIAL CHEMICALS CO.

Division of National Distillers Products Corporation

120 BROADWAY, NEW YORK 5, N. Y.

BRANCHES IN ALL PRINCIPAL CITIES

# What's YOUR problem?



Ralph E. Murnahan, of Standard Oil's Evansville office, is the lubrication specialist who keeps in constant contact with Gunnison Homes to make certain that there is no interruption of operation due to lubrication difficulties.

He is one of many lubrication specialists who make their headquarters in Standard's offices throughout the Midwest. These men have been specially trained in Standard's Lubrication Engineering Schools and, in addition, have a wealth of on-the-job experience.

To obtain the service of the lubrication specialist in your area, you need only call your local Standard Oil office. The lubrication specialist will discuss your lubrication problems with you... at no obligation to you, of course. He has a complete line of petroleum products to offer you, including:

**SUPERLA Greases**—Available in a wide range of consistency grades and in both lime-soap and soda-soap types. SUPERLA Greases cover a wide range of operations. These efficient products are comparable in quality with the highest type of special greases.

**STANOLITH Greases**—Because these unique lithium soap products possess the heat resistant properties of soda-soap greases and the water resistant properties of lime-soap greases, they offer a solution to lubrication problems caused by the presence of both heat and water.



ABOVE: Vital to the high production maintained by Gunnison Homes, Inc. is this 650-ton hydraulic press used to bond plywood panels into strong, durable wall sections.  
LEFT: Handsome, precision built homes, like the Gunnison Coronado pictured here, are built in a matter of hours.

## Answers a pressing need for Gunnison Homes, Inc....

• Gunnison Homes, Inc., situated in New Albany, Indiana, is one of the leaders in the field of manufactured homes. Key to continuous production of precision built homes at the New Albany plant is the 650-ton hydraulic press, shown above, which was installed in 1947. This press processes ten plywood panels every cycle by the combination of heat and pressure... a tough job and one requiring reliable hydraulic performance to maintain production schedules.

STANOIL Industrial Oil was installed in the press when it was put into operation six years ago. STANOIL has stood the test of severe operation... with no evidence of oil deterioration being found during a recent inspection of the hydraulic system. Operation has been efficient. Minimum make-up oil has been needed to



maintain the oil capacity of 450 gallons.

Find how STANOIL can benefit you by discussing this multi-purpose oil with a Standard lubrication specialist. You can contact him by phoning your local Standard Oil office. Or, write: Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Ill.

**STANDARD OIL COMPANY**



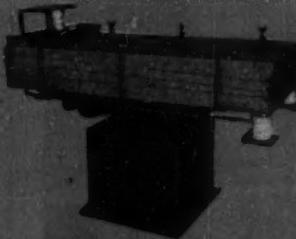
(Indiana)

# CONSULT SCHUTZ-O'NEILL

For the Correct Equipment and Process



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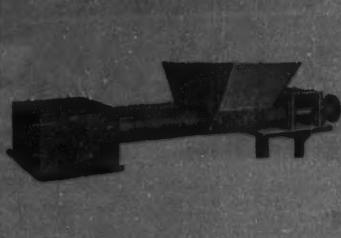
HAMMER MILLS



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LABORATORY MILLS

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Bridges Engineering Co.  
P. O. Box 186

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**SCHUTZ-O'NEILL COMPANY**

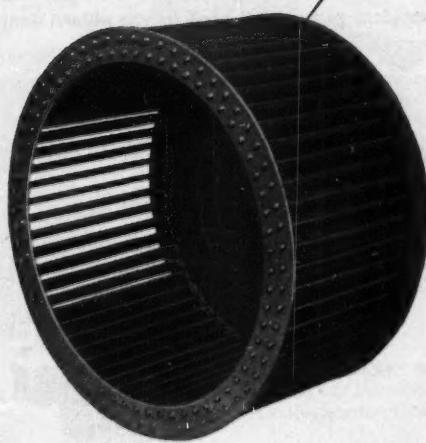
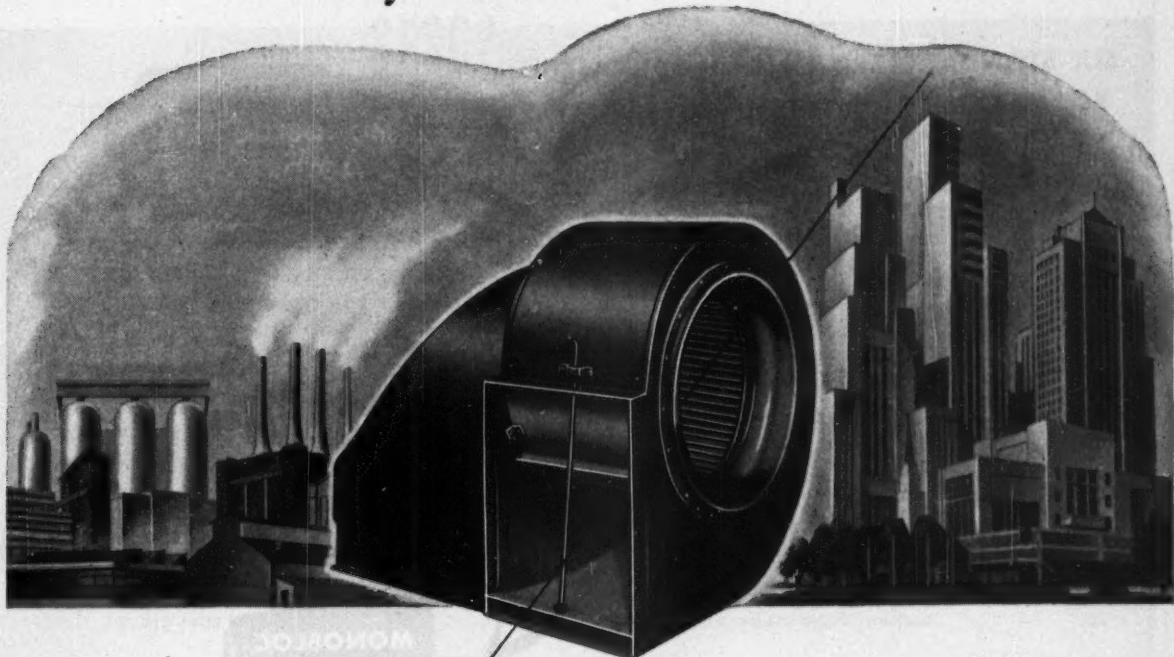
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# AMERICAN BLOWER

## Utility Sets



Need air in your business?

Want a "work horse" that has proved to be a good investment in hundreds of industries?

Then, put these time-proven, quality-built American Blower Utility Sets to work. They are unsurpassed for general ventilation where duct systems are required.

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**AMERICAN**  **BLOWER**

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

The heart of an American Blower Utility Set is this dynamically balanced Sirocco wheel which provides large volumetric capacities at low peripheral speeds.

*Serving home and industry:* AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

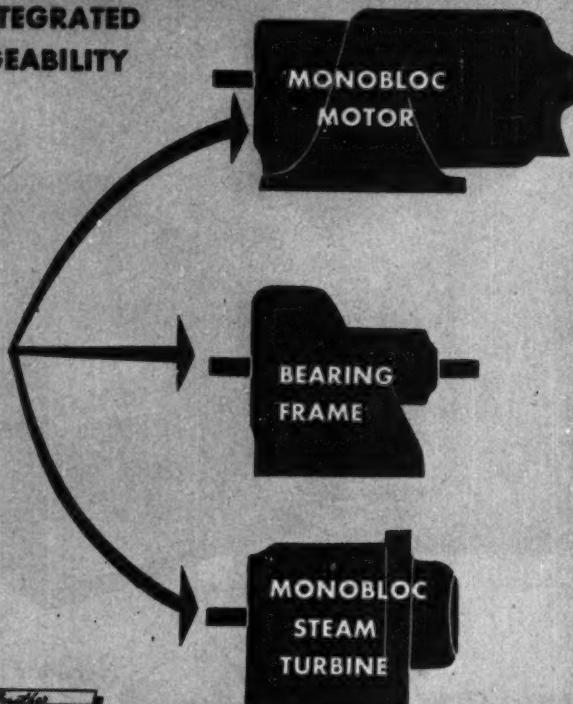
# How Worthington makes

SIX STANDARDIZED LINES INTEGRATED  
FOR MAXIMUM INTERCHANGEABILITY

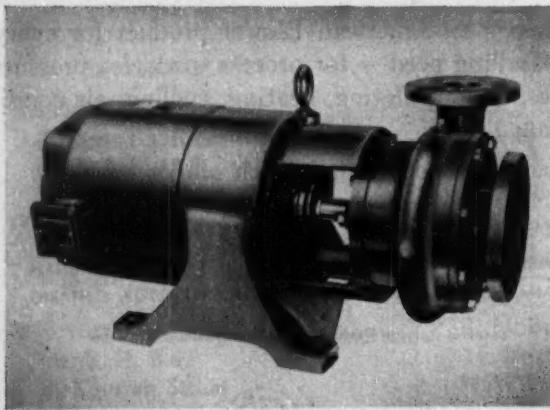
6 Sets of liquid ends



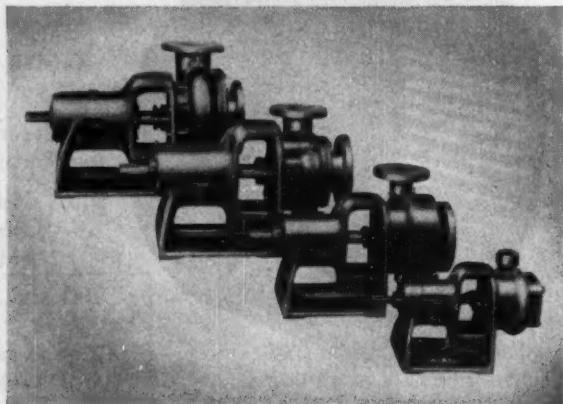
ANY OF WHICH  
WILL FIT



WORTHINGTON STANDARDIZATION assures you the one *right* pump for every job. Most "specials" can be assembled from standard parts and shipped to you without delay.



**THE WORTHINGTON MONOBLOC**, the pump with a built-in motor, has long been famous for its compact, streamlined design. It handles many different jobs because it uses any of the six liquid ends that are interchangeable and can be equipped with either conventional packing or mechanical seal.



**FRAME-MOUNTED PUMPS** use the same rugged mounting as the monobloc units and the six liquid ends fit in four frame sizes. Like the monoblocs, they use a standardized mechanical seal that can easily be changed in the field if necessary. They'll take any kind of drive readily available.

# standard pumps do special jobs

Worthington's **SESC\*** line provides for "custom" assembly from standardized parts with standardized mountings, materials and dimensions to give you exactly the centrifugal pump you need

When you order a Worthington centrifugal pump you get the one *right* pump for the job without compromise, without long delays and without paying a premium for a pump to meet "special" requirements.

Worthington can assure you this, because Worthington can assemble any of 60,000 different standard pumps, covering virtually every possible application, from 650 standardized parts. Nearly all *special* pumping needs can be filled with a Worthington *standard*.

Worthington SESC centrifugal pumps are husky and well-built—not flimsy, light-duty units. In fact, users find them of better construction than is usually available in custom jobs at higher prices.

To sum up, you can expect the following advantages when you buy Worthington centrifugal pumps:

- **Greater availability**, since Worthington is equipped to handle more requirements with a *standard* unit.
- **Broader selection** of ratings and special design features.
- **Easier servicing** with lower parts-inventory requirements.

Contact your local Worthington distributor or nearest Worthington district office. Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

\*SESC—Standardized End Suction Centrifugal

C.2.14



MANY YEARS OF DEVELOPMENT WORK coupled with Worthington's 112-year pumping experience has led to the development of the present Worthington line of centrifugal pumps. This is a view of a section of Worthington's Engineering Department which includes specialists in virtually every field of industry.

C.2.14



CENTRIFUGAL



ROTARY



STEAM



POWER



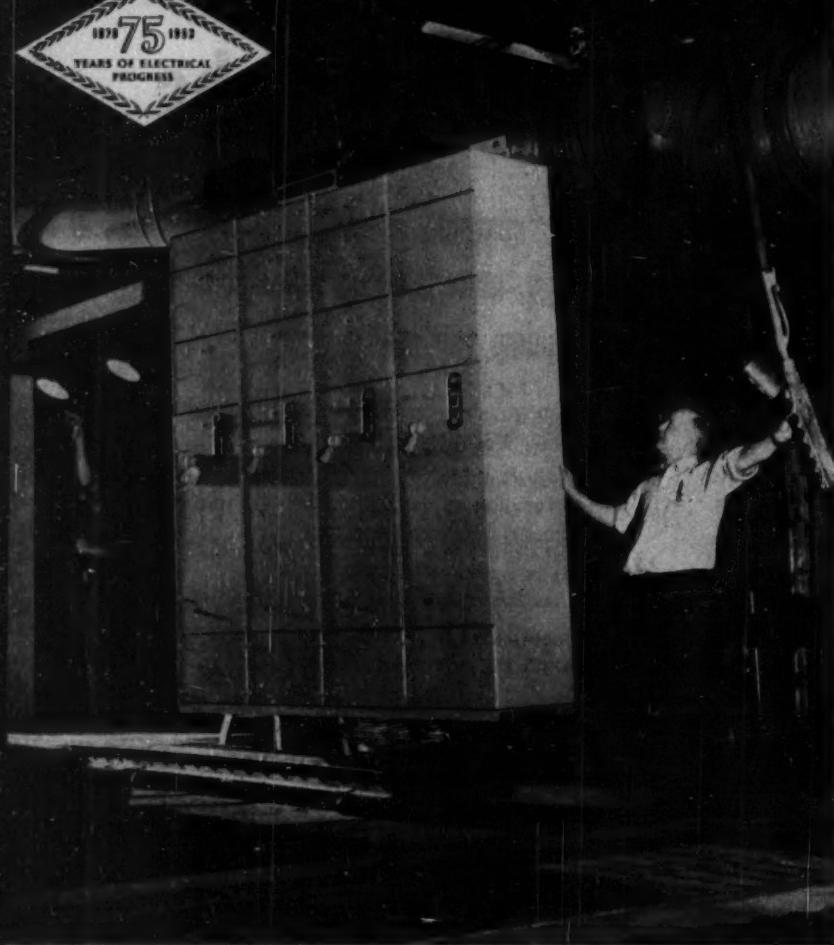
VERTICAL TURBINE

**WORTHINGTON**



Centrifugal Pumps

The World's Broadest Line Assures You The Right Pump For Every Job



## New G-E Motor Control Center Has Easiest-to-Interchange Units

The new General Electric motor control center is the most up-to-date equipment for the centralized control of a-c motors up to 200 horsepower. Each control center is planned for the job it is to handle, but it can rapidly be modified to meet changed requirements. Standard units can be easily interchanged or substituted, new units can be quickly added. Units may be mounted back-to-back in same standard enclosure. Master terminal boards may be located at either top or bottom of cabinet.

**ACCESSIBLE.** Installation is simple — just a matter of sliding the unit into its compartment. Stab-on connectors grab the vertical bus. Wiring

is easy because even pushbuttons and terminals are mounted on the unit frame for simple front-connecting. Doors swing more than 90°, so unit can be lifted out of compartment for accessibility from all sides. Barriers between units can be slipped out, making a four-inch wiring trough. Master terminal boards can be swung out of place for connecting without "fishing" of wires.

**FOR MORE INFORMATION,** contact your nearby General Electric apparatus sales office, authorized G-E agent or distributor, or write Section 781-1 for GEA-4979A today. *General Electric Company, Schenectady 5, New York.*

*You can put your confidence in—*

**GENERAL**  **ELECTRIC**



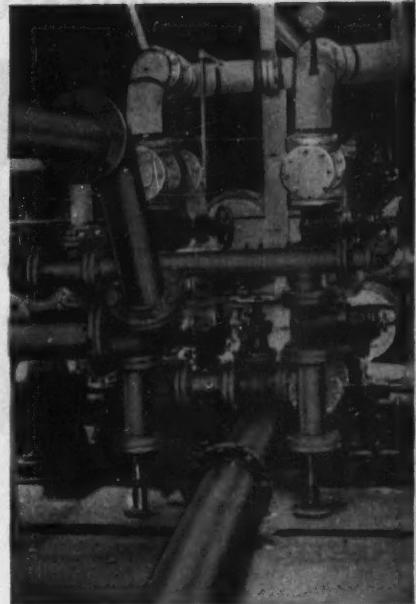
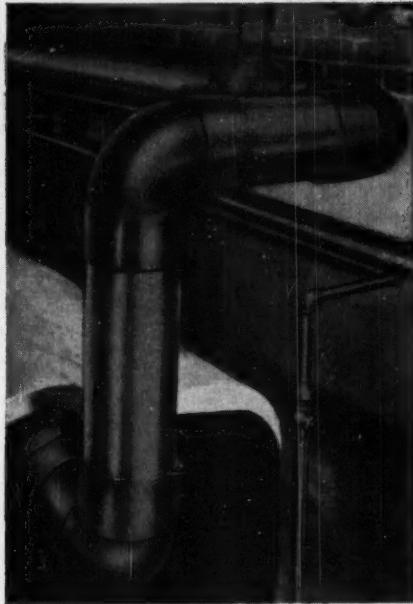
**INDIVIDUALLY PLANNED** motor control centers are manufactured and delivered completely wired and ready-to-install from this new General Electric motor control center production line.



**EASY TO INSTALL,** inspect, and interchange starters, which are assembled as complete units, including pushbuttons and wiring terminals for easy front-connecting. Door swings more than 90°



**HIGH-POTENTIAL TESTS** are made of each completed General Electric control center before shipment, to assure adequate short-circuit protection, safety for plant personnel and equipment.



## Quick Quiz on copper piping

**Q** Isn't copper tubing more expensive to use than piping made of other materials?

**A** In some cases, yes. In most cases, no. There are many conditions under which ANACONDA Copper Tube proves to be the least costly piping obtainable. Prevention of rust, corrosion and contamination, together with the lower labor costs of installing solder-type fittings, often more than offset differences in piping material cost.

**Q** Why is copper tube easier to install?

**A** There are many reasons. First, ANACONDA Copper Tube is light, easy to handle. Second, it comes in longer lengths, which saves cutting and fitting. Third, it is more flexible, can be bent on the job—again saving cutting and fitting. Fourth, required connections are fast and easy to make. No threading.

**Q** Are changes in piping systems hard to make where copper tubing is used?

**A** Definitely no. Once installed, copper tubes connected with solder fittings can be taken down, moved, or have new connections cut in faster and with less expense than with threaded pipe.

**Q** Where can I get more facts?

**A** A well illustrated booklet, "ANACONDA Copper Tubes for Industrial Applications," is available on request. It contains a wide range of information on copper tubes, their applications, advantages and installation. Numerous reference tables useful to user and installer are also included. For a copy of this booklet, ask for Publication C-24 and send your request to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anacinda American Brass Ltd., New Toronto, Ontario.



for better piping...use

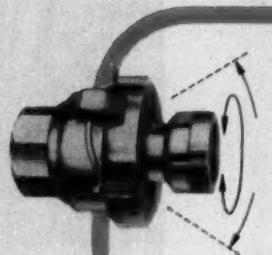
**ANACONDA<sup>®</sup>**  
**COPPER TUBES**

WHEREVER PIPING MUST MOVE

# —a specialized **BARCO** flexible joint!

for  
angular  
motion-

— also swivel motion

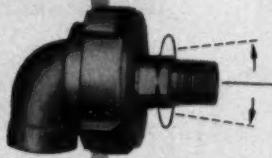


## —**BARCO BALL JOINTS**

"One joint does the work of two or more!"—because it moves in any direction. Standard the world over where low cost, leakproof movable joints are needed in piping handling steam, air, water, oil, gas, or chemicals. Many models available. Up to 40° side flexibility plus 360° swivel action. Also used to facilitate quick connection of piping, overcome misalignment. Pressures to 7,500 psi; temperatures to 1,000°F. 15 different sizes,  $\frac{1}{4}$ " to 12". Ask for Catalog No. 215.

for  
swivel  
motion-

— also limited angular motion



## —**BARCO SWIVEL JOINTS**

Self-aligning! Exclusive side flexibility (up to 10°) speeds up and facilitates installation; prevents binding. Widely used for making compact, low torque swivel connections to reciprocating or rotating parts on platen presses, tire molds, die casting machines, oil burners. Easy to position piping accurately—no sagging, drooping lines. Leakproof, safe—pressure or vacuum. Ratings as high as 600°F., 3,000 psi (hydraulic). Sizes,  $\frac{3}{8}$ " to 2"; angle or straight. Catalog No. 265.

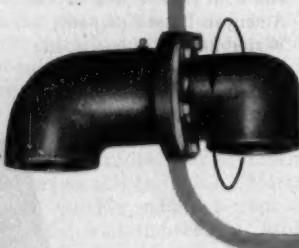
for  
continuous  
rotation-



## —**BARCO REVOLVING JOINTS**

Superior design insures trouble-free performance, minimum roll drag, and up to 50% power savings. Inherent low torque is little affected by increasing pressure, speed, or temperature. Parts are easily accessible. Light running action minimizes wear, permits free-floating installations. No adjusting necessary—long, leakproof service. Ratings to 250 psi (steam); 450°F. Single flow or syphon styles. Sizes  $\frac{1}{2}$ " to 2" and special to 5". Wide choice of models. For detailed information, ask for Catalog No. 300.

for  
swing  
motion-



## —**BARCO SWING JOINTS**

Barco's new line of ball bearing Swing Joints is complete with sizes and styles to meet every requirement on loading racks, fueling assemblies, and chemical applications. "O" ring gives long life, leakproof seal. Full bearing surface, swiveling 360° in one plane (single swing) or in two planes (double swing), supports normal piping. Ball bearings can't fall out. Built in steel for pressures to as high as 1500 psi (hydraulic); temperatures, -40° to 225°F. 11 styles: straight, angle, double angle, counter balance. Sizes 2", 2½", 3", 4". Catalog No. 400.

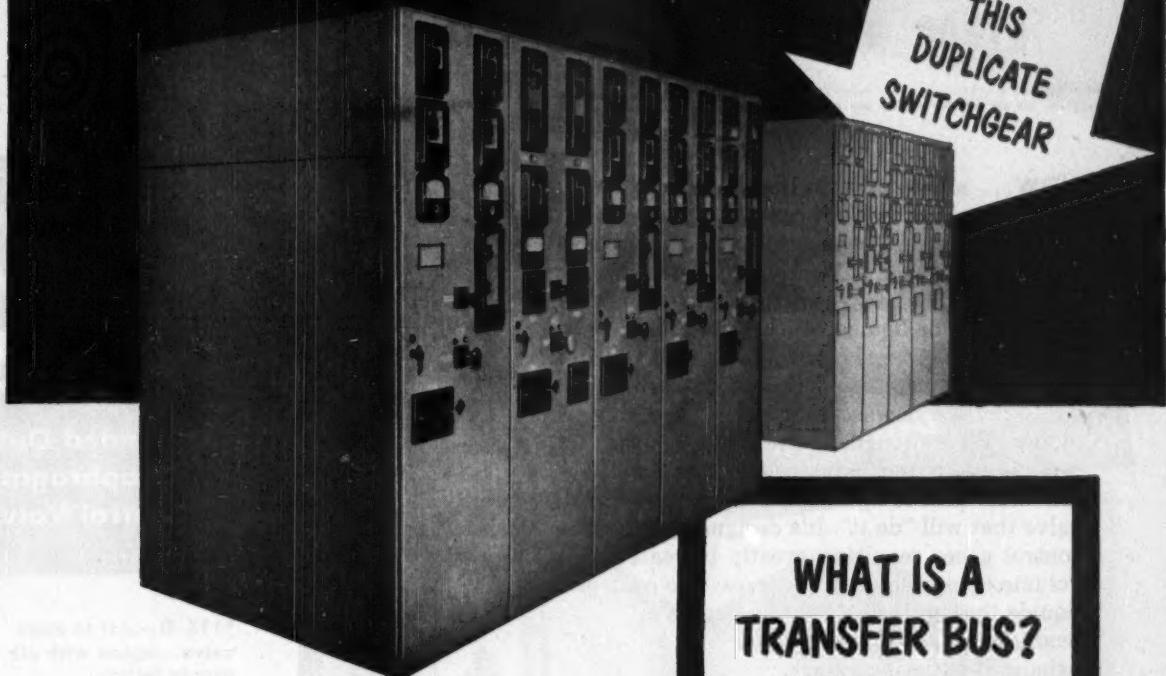
HIGH PRESSURE HYDRAULIC SWIVEL JOINTS—In addition to the four types of flexible joints illustrated above, Barco produces a complete line of High Pressure Hydraulic Swivel Joints for use with small diameter tubing or pipe. Send for Catalog No. 269.

# **BARCO** Manufacturing Co.

516E Hough St., Barrington, Illinois (A Chicago Suburb) In Canada: The Holden Co., Ltd.

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

# Switchgear ..With Transfer Bus Assures Power Continuity



## Saves 1/3 the Cost

You pay only for the addition of the transfer bus . . . not a complete set of duplicate switchgear with all of its expensive components. At least one-third is saved on entire installation.

## Saves 1/2 the Space

Allis-Chalmers supplies transfer bus in same cubicle as switchgear, without adding cubicles . . . thus cutting floor space one-half.

Ask an Allis-Chalmers engineer about transfer bus arrangements and what they can mean to your plant in savings and service. And learn too about the unusual features that make it so easy to install A-C switchgear. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3773

## WHAT IS A TRANSFER BUS?

It's a by-pass bus circuit that parallels the main switchgear bus . . . with means provided for switching loads to the transfer bus. Also makes it possible to withdraw and maintain circuit breakers, or inspect main bus without power outage. This method proved by utilities in hundreds of installations.

# ALLIS-CHALMERS



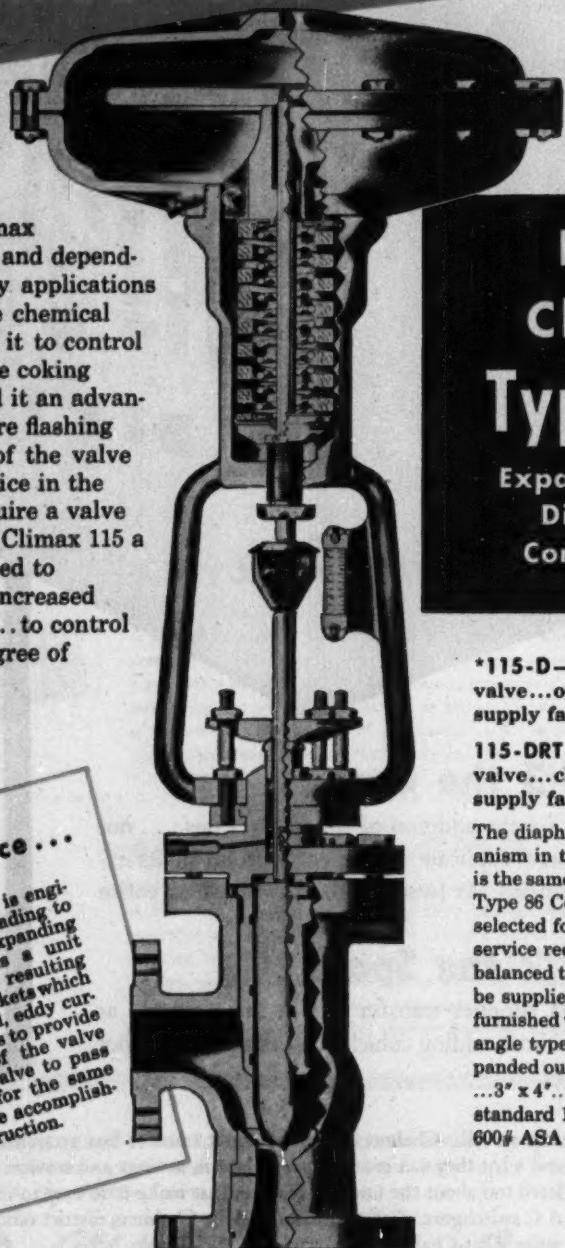
# a NEW BS&B Climax Control

Designed For **TOUGH** Service in The  
Process And Power Industries

**NOW...** a new valve in the Climax family of precision built controls and dependable performers. There are many applications for this angle type valve 115. The chemical and refining industries will want it to control residual oils or liquids which have coking properties. Power plants will find it an advantage for high pressure drops where flashing occurs in the downstream side of the valve piping. Where tough, severe service in the process and power industries require a valve that will "take it", you'll find the Climax 115 a valve that will "do it". It's designed to control gases requiring greatly increased volume upon release of pressure...to control liquids that are subjected to a degree of flashing that would render an expanded outlet necessary.

## For minimum turbulence...

The valve body of the Climax 115 is engineered with a sweep flow inlet leading to a venturi throttled valve seat expanding to the outlet...all designed as a unit for minimum turbulence. The streamlined flow eliminates pockets which are the cause of flow reversal, eddy currents and erosion. It also tends, eddy currents, to provide a maximum port efficiency which, in turn, allows the valve to pass greater quantities of fluid for the same diameter port than would be accomplished in a globe type of construction.



**BS & B**

**Climax**

**Type 115\***

Expanded Outlet  
Diaphragm  
Control Valve

\*115-D—Air to close valve...opens with air supply failure

115-DRT—Air to open valve...closes with air supply failure

The diaphragm motor mechanism in the Type 115 Climax is the same used in all Climax Type 86 Control Valves, selected for the particular service required. Pressure balanced top works can also be supplied. Type 115 is furnished with carbon steel angle type bodies in expanded outlet sizes— $2'' \times 3''$  ... $3'' \times 4''$ ...and  $4'' \times 6''$  with standard 150#, 300#, and 600# ASA flanges.

CLIMAX

**BS&B**

**BLACK, SIVALLS & BRYSON, INC.**

CLIMAX CONTROLS DIVISION, DEPT. 4-N4

7500 East 12th St.

Kansas City 3, Missouri



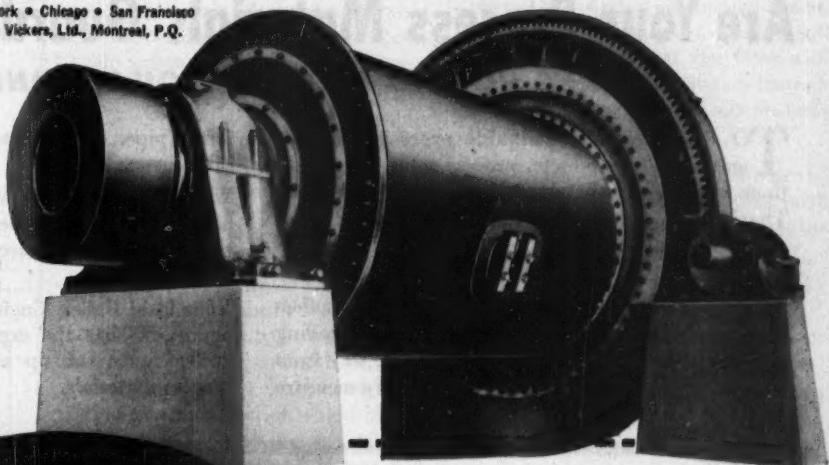
# Get out from under HIGH GRINDING COSTS

For over half a century, Traylor has been building grinding mills to meet the special needs of leading chemical processors throughout the world. This experience has produced many major improvements that have become accepted standards for modern grinding mill design. Precision cut steel driving gears with high and low addendum . . . pressure lubricated main bearings to eliminate "dry" starting . . . trunnions cast integral with detachable heads . . . are Traylor developments that have insured lower maintenance costs and more dependable operation for Traylor Grinding Mill customers. Mail the coupon for Bulletin 7121. It will take a big load off your shoulders if high grinding costs are holding your profits down.

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**TRAYLOR** builds a complete line of grinding mills to handle wet or dry, coarse or fine grinding. Types include: Rod, Compartment, Ball, Tube, Ball Tube and Pebble Mills.



Sure I want to get out from under high grinding costs.  
Send me Bulletin 7121.

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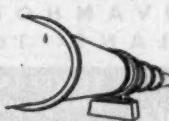
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Primary Gyratory Crushers



Rotary Kilns



Secondary Gyratory Crushers



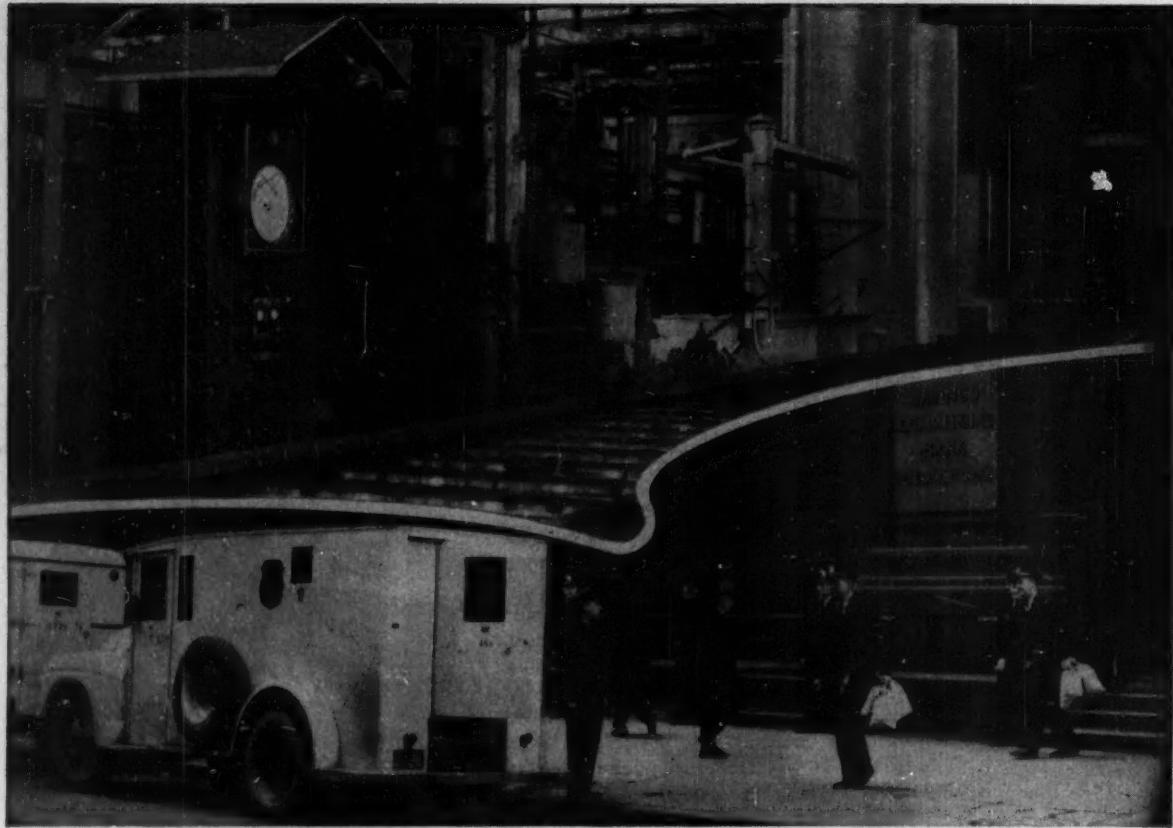
Ball Mills



Jaw Crushers



Apron Feeders



Modern Safeguards—Brink's for Money, Bailey for Process Materials

## Are Your Process Materials Guarded As Well?

**HERE'S HOW TO PREVENT SPOILAGE AND WASTE . . .**

**T**O avoid waste of valuable process materials and finished products, process rates and conditions must be accurately measured and controlled. That's where Bailey Meters, Analyzers and Controllers can help you to improve the efficiency of your plant.

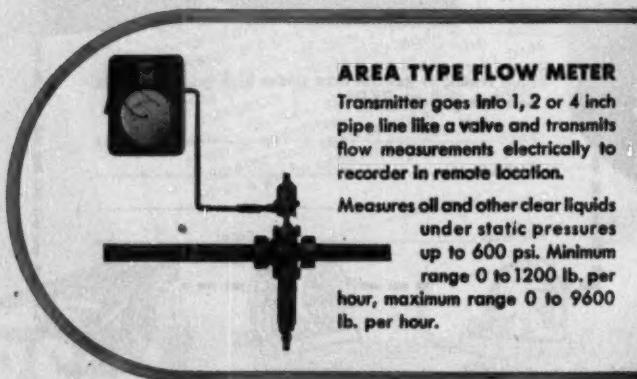
Take flow for instance. Bailey Meter Company offers a complete line of flow measuring and controlling equipment for applications ranging all the way from high pressure steam to low pressure gas. We measure

flow in pipes, open channels, ducts, furnaces, smelters, kilns, ovens, dryers.

When you call Bailey Meter Company, you get the help of years of experience as well as recommendations from a wide selection of measuring and controlling devices.

Your local Bailey Engineer is as near as your telephone. He has the experience and the equipment necessary to set up an effective guard for your process materials.

P-26



### AREA TYPE FLOW METER

Transmitter goes into 1, 2 or 4 inch pipe line like a valve and transmits flow measurements electrically to recorder in remote location.

Measures oil and other clear liquids under static pressures up to 600 psi. Minimum range 0 to 1200 lb. per hour, maximum range 0 to 9600 lb. per hour.

**BAILEY  
METER  
COMPANY**



1054 IVANHOE ROAD  
CLEVELAND 10, OHIO

*Process  
Controls*

TEMPERATURE • FLOW  
PRESSURE • LEVEL  
GAS ANALYSIS • RATIO



# DARCO

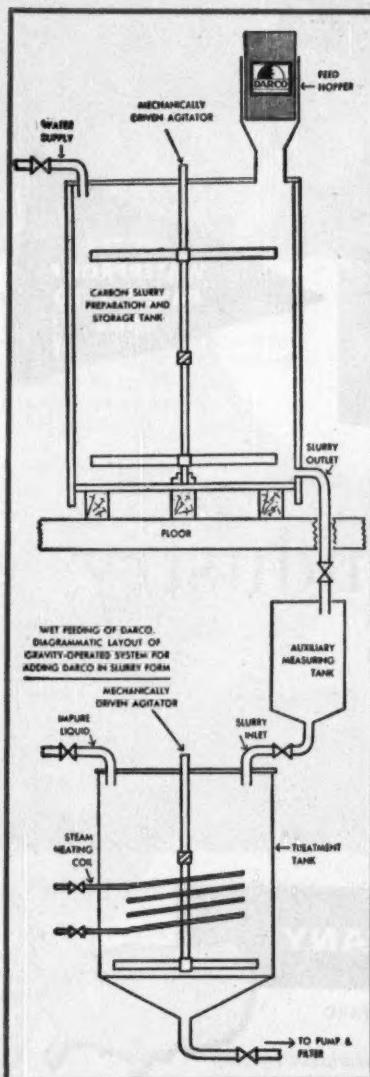
*Dispensed*

**DARCO DEPARTMENT • ATLAS POWDER COMPANY**  
Darco General Sales Offices—60 EAST 42nd STREET, NEW YORK 17, N.Y.  
ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

## WET FEEDING... a convenient way to apply Darco to batch processes

Feeding Darco in slurry form is widely used in batch process treatment. It has the advantage of permitting easier measurement of Darco dosage, and reduces dust.

The diagram illustrates a typical gravity-flow system. Darco is fed through a hopper into the slurry tank, where it is mixed with a predetermined volume of water, to give a slurry of known concentration. As Darco is needed, the required volume of slurry is drawn off to the measuring tank, and then transferred into the treatment tank.



A commonly used slurry contains one pound of Darco per gallon. This concentration is prepared by mixing 2,000 pounds of Darco with about 1,800 gallons of water . . . making a total volume of 2,000 gallons of slurry. Concentrations higher than two pounds of Darco per gallon are not ordinarily used, because of difficulty in agitation and transfer.

The water in the slurry, of course, dilutes the solution being treated. Suppose, for example, that a final solution should contain 2,000 pounds of solids per 1,000 gallons, and that 50 gallons of slurry are added during treatment. To reach the required solids concentration, it would be advisable to start with a concentration of 2,000 pounds of solids per 955 gallons.

The contents of the slurry tank should be continuously agitated to keep the slurry uniform in concentration. Carbon settles out during periods of extended shutdown, and care should be taken in starting the agitator motor until carbon is again in suspension.

Darco's ready wettability, incidentally, makes slurries easy to prepare . . . keeps dust to a minimum.

## Solving a colloid purification problem

A problem of how to purify colloidal suspensions arose in connection with the filtration of blood plasma extender for military use. The same problem occurs in filtering such materials as pectin, egg albumen and other colloidal solutions, as well as strongly alkaline solutions.

In such solutions, finely divided carbon refuses to hang together in clumps, as it normally does—that is the carbon is "peptized" and it becomes hard to filter out.

Finely divided Darco can still be used in these instances, without resorting to more expensive and less highly adsorptive granular grades. The secret lies in the method of filtration. Instead of adding Darco to the solution, where it will be peptized, just coat the filter with carbon and pump the solution through it. This way, the solution only contacts the Darco at the filter cake.

Further recommendations: Pre-coat the filter with a "tight" diatomaceous earth filter aid, and add a faster filter aid to the solution along with the carbon.

## Entrapped air may hinder decolorizing ability

It sometimes happens that certain solutions that are treated with carbon contain materials sensitive to oxidation. In this case, air entrapped in the carbon may introduce enough oxygen to cause intensification of color. Although such cases are relatively rare, they can be solved by removing air from the pores of the carbon particles. The simplest way to do this is to boil Darco in the water or whatever solvent is to be used for 20 to 30 minutes. This displaces nearly all the entrapped oxygen, and greater effectiveness is realized from the carbon.

# Chase Bag makes

POLYETHYLENE  
BAG AND DRUM  
LINERS



MULTIWALL  
BAGS



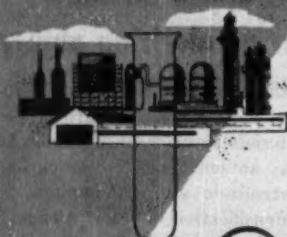
SHARKRAFT  
BAGS



PROTEX  
WATERPROOF  
PAPER LINED  
BAGS



## for the Chemical Industry



Complete protection of your product  
plus attractive appearance  
... the result of  
over 100 years experience  
in designing and making bags.



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# New Trends in Mechanized Materials Handling

# WITH ALLIS-CHALMERS TRACTOR SHOVELS

#### **Feeds Hoppers, Conveyors**

**Special high-speed reverse increases output on short runs between stockpile and hopper. Steel tracks stand up in cullet and other sharp, abrasive material.**



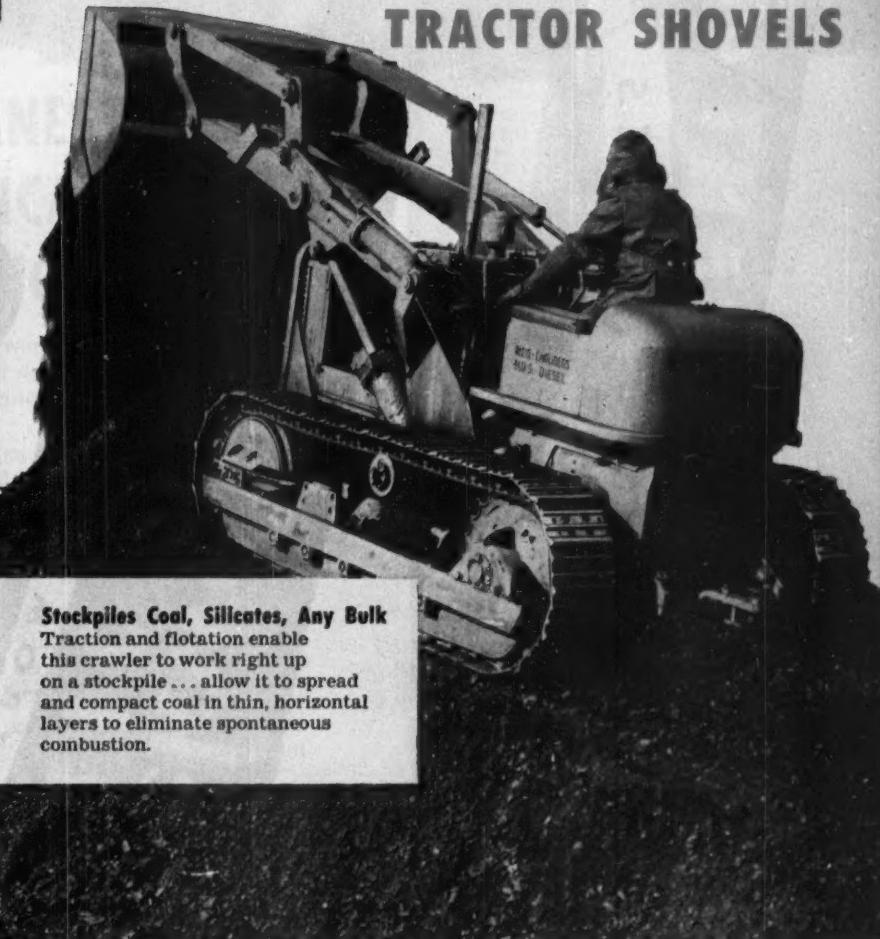
#### **Excavates, Loads Trucks**

This busy crawler-mounted shovel has the power to dig into hard-packed materials — and bring it out, a full cubic yard at a scoop. In handling light materials, an interchangeable two-yard bucket doubles its capacity.



#### **Handles Packaged and Solid Materials**

- With Lift Fork in place of bucket, the HD-5G skids, carries and stacks palletized loads weighing up to 4,000 lb. Stacking height beneath forks is 108 inches.



**Stockpiles Coal, Silicates, Any Bulk**

**Traction and flotation enable this crawler to work right up on a stockpile . . . allow it to spread and compact coal in thin, horizontal layers to eliminate spontaneous combustion.**

Crawler tractors — basic machines on earth-moving and construction jobs — are now solving more and more bulk materials-handling problems in industry with hydraulic front-end shovels. And spear-heading this new trend is the Allis-Chalmers HD-5G — thousands of which are now in use in plants of all types. This multi-purpose crawler combines power, traction and maneuverability with a wide selection of hy-

**draulically operated attachments  
for a variety of material handling  
jobs.**

Get the full story on how crawler tractor power and versatility can help mechanize your tough jobs. Ask your Allis-Chalmers dealer about the HD-5G and these three larger tractors shovels: 2-yd. HD-9G, 3-yd. HD-15G and 4-yd. HD-20G. Light materials buckets range from 2 to 7 cu. yd.

**ALLIS-CHALMERS**  
TRACTOR DIVISION - MILWAUKEE 1, U.S.A.

**Here are a few of the other jobs the HD-5G and its attachments will handle:**

**Maintains yards and roads with bulldozer or shovel . Clears snow from parking areas . Moves machinery and other heavy materials with Crane Hook attachment . Spots railroad cars at loading docks . Digs trenches for pipe or foundation footings with Trench Hoe attachment**

# NOW AVAILABLE



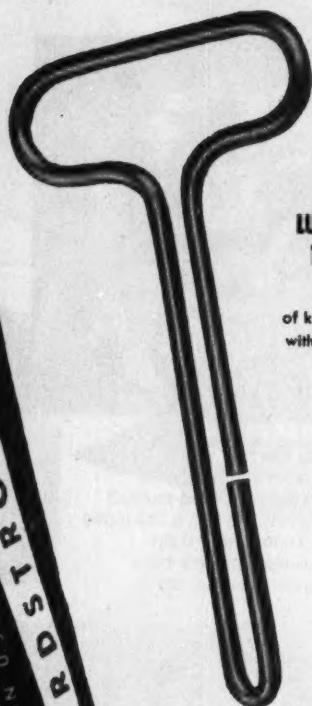
#### GUN LUBRICANT TUBE

Actual size of  
gun lubricant tube for  
Nordstrom valves.



#### BULK LUBRICANT TUBE

Actual size of  
bulk lubricant tube for  
Nordstrom valves.



#### LUBRICANT TUBE KEY

Actual size  
of key supplied  
with each tube.

# IN TUBES!

FOR LUBRICANT SCREW AND  
LUBRICANT GUN USE

Lubricant  
Tubes

## SIMPLEST, CLEANEST, MOST ECONOMICAL METHOD OF VALVE LUBRICATION

The new Rockwell lubricant tubes were developed to provide a better means of lubricating Nordstrom valves. They are a big time and money saver for maintenance departments; a great convenience to supply stores.

For Nordstrom valves equipped with lubricant screws, you just insert tube spout in the valve shank and turn key until lubricant chamber is filled. It's easy and quick! The lubricant is always kept fresh . . . no chance for contamination by dirt or grit. The inventory problem is simplified—one tube fits all sizes and types of Nordstrom valves.

If you lubricate Nordstrom valves by lubricant gun, then specify the new Rockwell gun tube. Insert it in your gun and turn the key until all lubricant has been emptied into the barrel. The whole job takes only a few seconds.

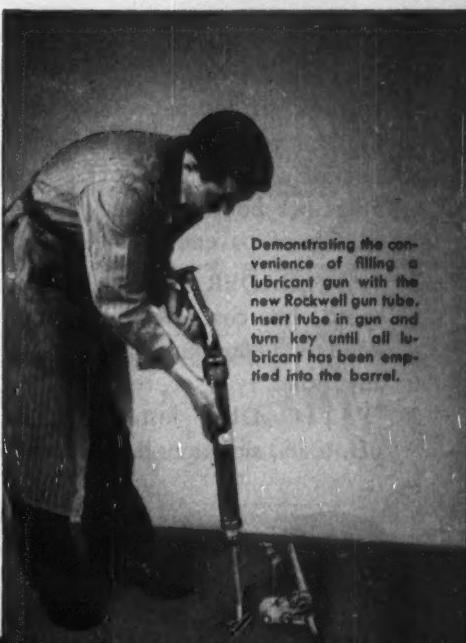
Rockwell bulk lubricant tubes are normally packaged in boxes of four; however, single tubes are also available. Gun lubricant tubes are supplied in boxes of six.

The most commonly used Rockwell Nordcoseal lubricants are now produced in tube, stick and bulk form. Other Nordcoseal lubricants and Hypermatic, the energizable lubricant, will still be available in stick and bulk form.

To assure positive valve closure, quick easy operation and longest valve life, use *only* genuine Rockwell lubricants in Nordstrom valves.

Write for bulletin V-220 describing Rockwell lubricants for Nordstrom valves. Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

Maintenance man demonstrates ease of lubricating a Nordstrom valve with the new Rockwell bulk lubricant tube. Insert spout of tube in valve shank and turn key until lubricant chamber of valve is filled.



Demonstrating the convenience of filling a lubricant gun with the new Rockwell gun tube. Insert tube in gun and turn key until all lubricant has been emptied into the barrel.

## ROCKWELL Built Nordstrom Valves

*Lubricant-Sealed for Positive Shut-Off*





IN BINS

or  
**BOXCARS**

**PAYLOADERS**

## Blast Bulk Handling Costs

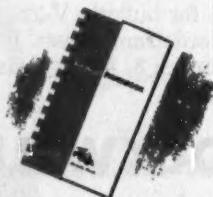
Scoop-up? Carry? Dump? Spread? Load? Pile? Pour? . . . "PAYLOADER" tractor-shovels will do all of these bulk material handling jobs for you and many more . . . up to three tons at a time . . . travel at speeds up to 28 miles per hour . . . work inside buildings or outside on pavement or ground.

"PAYLOADERS" bring a combination of speed, low cost, flexibility and versatility to your bulk-handling problems unmatched by any other type of equipment. Thousands of "PAYLOADER" installations in all kinds of plants and situations have accomplished tremen-

dous cost reductions through savings in time and labor and through increased production. Our broad experience, plus that of your Hough Distributor, is available to help solve your bulk material handling problems, and without obligation. The Frank G. Hough Co., 754 Sunnyside Ave., Libertyville, Ill.

### FREE HANDBOOK

Tells how and where to look for signs of inefficient bulk materials handling . . . how to analyze, organize and set up an efficient handling system. Plus many useful tables and data. Write for "Bulk Materials Handbook."



# PAYLOADER®



**These are the  
FACTS  
complete details  
available on request**

If you are now using COOPER ALLOY stainless steel valves you know all about the plus factors in quality and design that are yours at no extra cost. If you are using any other brand, you owe it to yourself to get the facts and make the comparison. For the full story on how competitive 2" gate valves designed for the same service differ in important service features, write for your free copy of the 2" valve Comparison Chart.

**STAINLESS STEEL  
VALVE COMPARISON CHART**

BASED ON 2" GATE	COOPER ALLOY	COMPETITORS		
		A	B	C
Ball and socket rotating type disc for positive seating with minimum galling	✓	✓		
Discs and seats designed for simple reconditioning in the field	✓	✓		
Centerless ground stock to cut packing wear	✓	✓		
3/4" minimum stem diameter to assure rigidity	✓		✓	✓
Deep stuffing box with six turns of 1/4" square packing	✓		✓	
Packing gland designed to deliver square, uniform compression	✓			
Two piece gland construction to prevent gouging of the stem	✓	✓		✓
Swinging eyebolts to simplify repacking and provide added safety	✓			
Simplified yoke nut construction to permit replacement without interrupting service	✓			✓
Grease fitting to eliminate friction on yoke nut during opening and closing	✓			
100% x-ray of vital cast components	✓			
A stainless steel valve designed and produced by stainless steel specialists	✓	✓		
Stocked in major industrial areas by nationwide distributor organization	✓		✓	✓
Rugged construction for tough corrosive service—compare these weights!	33-lbs.	28-lbs.	28-lbs.	24-lbs.
7" minimum diameter handwheel for simplified hand closing	✓			

CUT OUT AND MAIL COUPON BELOW

- - - - -  
**THE  
COOPER ALLOY  
FOUNDRY CO. • HILLSIDE, NEW JERSEY**

Please send along \_\_\_\_\_  
 my copy of your \_\_\_\_\_  
 detailed chart com-  
 paring competitive 2"  
 stainless steel gate  
 valves

Name \_\_\_\_\_

Position \_\_\_\_\_

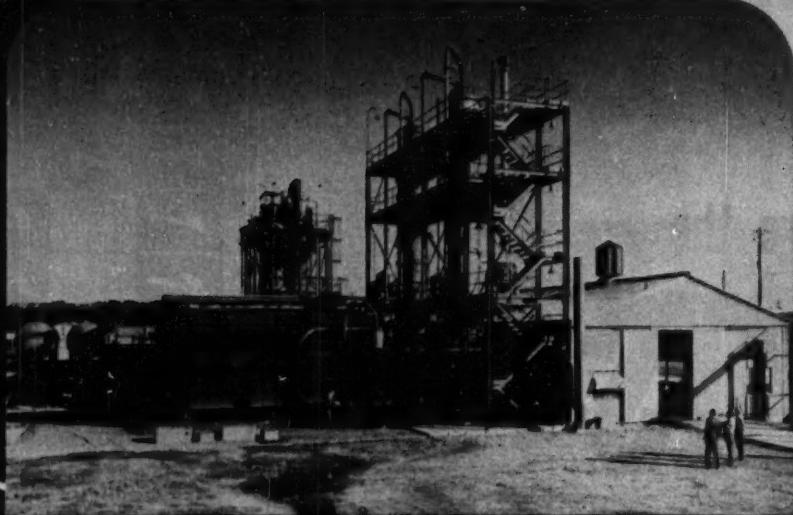
Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



These two nitric acid plants at Sterlington, La. were designed and built by C & I for Commercial Solvents Corp. Completed in 1952, the plants can produce a daily total volume of 120 tons of nitric acid, for use in the production of fertilizers.



"Build three more just like 'em"

says COMMERCIAL SOLVENTS CORP.

The best testimonial is a repeat order. That's why C & I is proud of the fact that 3 more plants like these recently erected ones have been ordered by Commercial Solvents Corp. When completed, total capacity of the five lines will be better than 300 tons of nitric acid per day.

In recent years, over 90% of U. S. nitric acid plants have been built by C & I. With its vast experience in engineering, design, and construction, C & I delivers your nitric acid plant at a **FIXED COST . . . on a FIXED DATE**. Sizes range from 10 to 200 tons per day.

C & I is also prepared to build Neutralizer, Ammonium Nitrate and Complex Fertilizer plants.

Specialists in the Processing of Anhydrous Ammonia



of Anhydrous Ammonia

**THE CHEMICAL & INDUSTRIAL CORP.**

CINCINNATI 26, OHIO



# With ESSO Solvents

Versatility  
is  
assured  
too!

**ESSO SOLVENTS** are being used in more and more industries where processing requires **versatility** plus dependability. A great many different industries such as paint—textiles—chemicals—food packaging—leather—many others are using versatile Esso Solvents.

**YOU GET ALL 6 OF THESE  
IMPORTANT FEATURES  
WITH ESSO SOLVENTS**

1. Multi-storage availability — water terminals in industrial centers.
2. Uniformity — made in modern refineries from carefully selected crude oil sources.
3. Economy — A storage facility near you for low freight cost and quick delivery.
4. Controlled evaporation — available in a wide range of evaporation rates with precise characteristics to meet your requirements.
5. Solvency — Esso aliphatics and Solvesso aromatics cover both high and low solvency ranges.
6. Modern handling methods — separate tank storage, pumping lines, tank cars and trucks, are used throughout in all Esso Solvent handling operations.

Esso Solvents:  
versatility and  
dependability  
with controlled  
high quality.



## PETROLEUM SOLVENTS

SOLD IN: Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md., D. C., Va., W. Va., N. C., S. C., Tenn., Ark., La.

**ESSO STANDARD OIL COMPANY**  
Boston, Mass.—New York, N. Y.—Elizabeth, N. J.  
Philadelphia, Pa.—Baltimore, Md.—Richmond, Va.  
Charleston, W. Va.—Charlotte, N. C.—Columbia, S. C.  
Memphis, Tenn.—New Orleans, La.

# This STAINLESS CLAD TOWER



*diameter 7' - length, 75'  
weight approximately 34 tons  
stainless clad 20% - type 316*

## TYPICAL EXAMPLE OF SKILLED PLATE FABRICATION



... yes, DOWNINGTON's experience and research in the fabrication of various grades of Carbon Steel, Stainless Steels, Nickel-Clad, Stainless-Clad, Monel-Clad, Cupro-Nickel, Aluminum, etc., may be of help to you. We are equipped with the most modern facilities to handle complete jobs, within our limitations, in the correct alloys and methods of fabrication required to assure maximum operating efficiency.

DOWNTON also maintains a Heat Transfer Division under the direction and supervision of men thoroughly trained and experienced in this field. Our Engineering Consultation is at your service to aid you in preparation of plans and specifications for definite jobs.

*Useful literature sent upon request on your business letterhead. Remember:  
"Your Needs are Our Specialty!"*



**DOWNINGTON IRON WORKS, INC.**  
DOWNINGTON-PENNA.

DIVISION OF  
PRESSED STEEL  
TANK COMPANY



STEEL AND ALLOY PLATE FABRICATION AND HEAT EXCHANGERS

*Foxy* for HIGH PRESSURES

# Atkomatic

## HIGH PRESSURE ELECTRIC VALVES

ATKOMATIC HIGH PRESSURE VALVES are designed to handle pressures to 3,000 psi. Standard AC and DC voltages. Sizes range from  $\frac{1}{4}$ ",  $\frac{1}{2}$ ",  $\frac{3}{4}$ ", 1" and  $1\frac{1}{2}$  inches.

Valves are globe type, pilot operated, piston actuated with only 3 moving parts. Suitable for operations on air, gas, oil, water, etc.

Optional equipment includes explosion proof coil housings made of heavy cast iron available in all sizes.

Bubble tight pilot valve assembly available for operations where leakage cannot be tolerated. This assembly eliminates metal-to-metal Pilot valve seat seal.

Use coupon below . . . write today for more information.

### REPRESENTATIVES WANTED

Atkomatic Valve Company has some territories available for Manufacturer's Representatives. For further information write to General Manager, Atkomatic Valve Company, 545 Abbott Street, Indianapolis 25, Indiana.

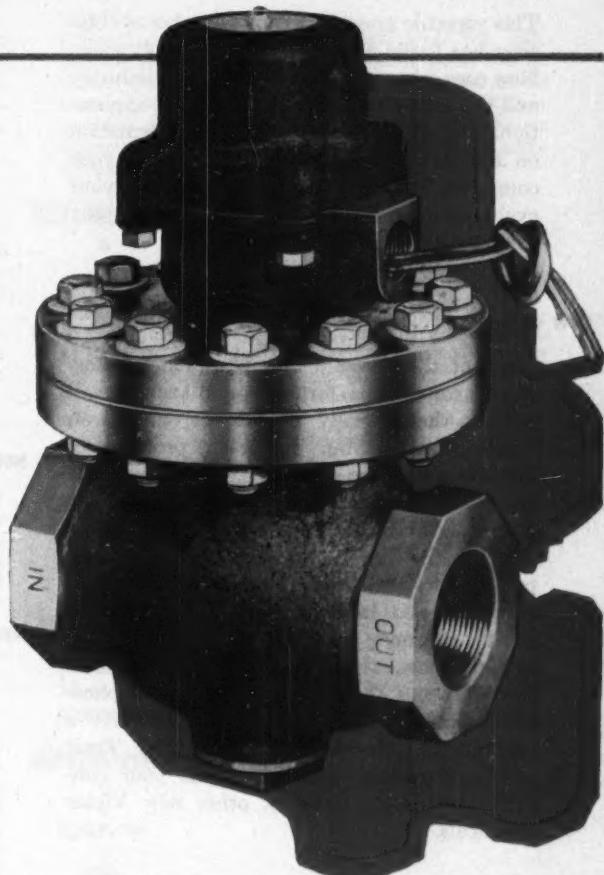
LOOK TO . . .

# Atkomatic

SOLENOID

ELECTRIC VALVES

CHEMICAL ENGINEERING—April 1953



ATKOMATIC VALVE COMPANY  
525 Abbott Street, Indianapolis 25, Indiana

Gentlemen: Please send more information on the Atkomatic Solenoid High Pressure Electric Valves.

Name..... Title.....

Company.....

Address.....

City..... State.....



(scanning time: 1 min. 50 sec.)

#### VICTOR PHOSPHORUS CHLORIDES . . . IDEAL CHEMICALS FOR YOU

This versatile group of Victor phosphorus chlorides has found a good measure of application. New uses are now being considered by industry and the future holds promise of broad application. You may get an idea from the information on the following page that can benefit your company. These chemicals are offered for your evaluation. Experimental samples are available. Mail the coupon.

#### NEW CHEMICALS . . . NEW POSSIBILITIES FOR YOU

Users of the newer Victor phosphates, phosphorus compounds, formates, and oxalates will tell you that it really pays to keep an eye on Victor research. Many important problems of industry have been solved by Victor's technical and research staffs through development of new chemicals and new uses. In some instances, plus benefits like the addition of new and impelling sales features for their products, lower operating and labor costs, more production, greater efficiency were gained.

Right now, there are several new Victor developments that offer promise. The phosphorus chlorides described here may solve a product or process problem for you. Their unique properties definitely merit your consideration as do those of other new Victor chemicals.

#### RESEARCH . . . ANOTHER DEPENDABLE VICTOR FACILITY

For 55 years, Victor has specialized in the development and manufacture of phosphates, phosphorus compounds, formates, oxalates. Victor recognizes the importance and contributions of an expanding and continuing research program. That's why you can depend on Victor research for useful developments that can aid you and make your work easier and your company's process and products better. It will pay you to keep an eye on Victor Research.

Look, also, to Victor for dependable service, for dependable chemical manufacturing standards, for dependable product quality and purity. Victor's facilities and service to industry are unmatched in this field. When selecting a source of supply, be guided by this fact: Victor is recognized as . . . the dependable name in chemicals.

#### HELP FOR PRODUCT PROBLEMS

If you have a product or process problem, bring it to Victor. Our technical and research people and laboratories are geared to aid industry. Your inquiry is invited.

#### NEW FOLDER ON VICTOR RESEARCH CHEMICALS AVAILABLE

##### MAIL THE COUPON FOR YOUR COPY

A new, handy folder which describes 45 Victor research chemicals has just been completed. You will find it to your advantage to be one of the first to receive a copy. One or more of these interesting chemicals may offer possibilities to you. Mail the coupon today for your copy.

#### VICTOR CHEMICAL WORKS

141 W. Jackson Blvd., Chicago 4, Ill.

Please send without cost or obligation:

- Sample of Phosphorus Trichloride
- Sample of Phosphorus Oxychloride
- Sample of Phosphorus Thiochloride
- Sample of Benzene Phosphorus Dichloride
- Sample of Benzene Phosphorus Oxydichloride
- Sample of Benzene Phosphorus Thiadichloride
- Sample of Benzene Phosphinic Acid
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- New Folder 45 Victor Research Chemicals

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COMPANY \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

(Fill in and attach to company letterhead)

# UNIQUE PROPERTIES OF

## VICTOR PHOSPHORUS CHLORIDES

### PHOSPHORUS TRICHLORIDE



Phosphorus trichloride is a clear, colorless liquid. It decomposes in water to give phosphorous and hydrochloric acids, and is chemically very reactive. Typical quality: Boiling range 75.5°C.-77.0°C. at 760 mm. Uses: Chlorinating agent in organic synthesis; intermediate in production of phosphites, organic chemicals. Available in tank cars and returnable drums.

### PHOSPHORUS OXYCHLORIDE



Phosphorus oxychloride is a water-white to slightly yellow liquid. It decomposes in water to yield phosphoric and hydrochloric acids, and is chemically very reactive. Typical quality: Boiling range 106°C.-108°C. at 760mm. Uses: Intermediate in production of organic chemicals; as a chlorinating agent, and catalyst. Available in tank cars and returnable drums.

### PHOSPHORUS THIOCHLORIDE



Phosphorus thiochloride (thiophosphoryl chloride) is a faint yellow to colorless liquid with a distillation range of 120-125°C. Typical analysis: 18.5% phosphorus and 18.6% sulfur. Uses: Intermediate in chemical manufacture. Typical end products are oil additives, ore flotation agents, and insecticides containing both phosphorus and sulfur.

### BENZENE PHOSPHORUS DICHLORIDE



(Phenyl dichlorophosphine). Mol. Wt. 179. Specific gravity 1.315 at 25°C. Boiling point 224.6°C. at atmospheric pressure. A colorless liquid which fumes in air. It is a highly reactive acid chloride which hydrolyzes in water and reacts with alcohols, phenols, amines, and aldehydes. Adds oxygen, sulfur and halogens. Suggested uses: As an intermediate in organic synthesis.

### BENZENE PHOSPHORUS OXYDICHLORIDE



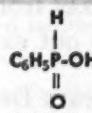
(Phenyl dichlorophosphine oxide). Mol. Wt. 195. Specific gravity 1.375 at 20°C. Boiling point 258°C. (atm.). Colorless liquid of faint fruity odor. Soluble in benzene, chloroform, carbon tetrachloride. It is a reactive acid chloride. Suggested uses are: As an intermediate for synthesis of plasticizers and oil additives, and in general organic synthesis.

### BENZENE PHOSPHORUS THIODICHLORIDE



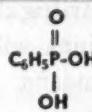
(Phenyl dichlorophosphine sulfide). Mol. Wt. 211. Specific gravity 1.376 at 13°C. Boiling point 205°C. at 130 mm. A colorless liquid which fumes slightly in air. It is a reactive acid chloride which hydrolyzes very slowly in water but reacts with alcohols, phenols, and amines. Suggested uses are: As an intermediate in organic synthesis and as an additive in extreme pressure lubricants.

### BENZENE PHOSPHINIC ACID

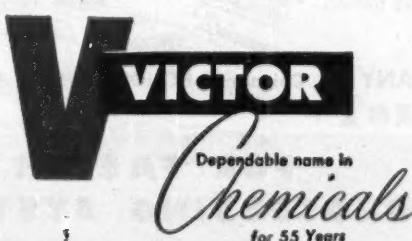


Mol. Wt. 142. Melting point 84-85°C. White crystals soluble in alcohol and water. Slightly soluble in ether. Monobasic acid. It is a stabilizer for vinyl resins, and a general anti-oxidant.

### BENZENE PHOSPHONIC ACID



Mol. Wt. 158. Specific gravity 1.475. Melting point 164-165°C. White crystals. Strong dibasic acid. Soluble in water, alcohol, ether. Stable in air. Suggested uses: Catalyst for urea formaldehyde and related resins. Intermediate for metallic salts used as anti-fouling agents in paint, and oxidation catalyst.

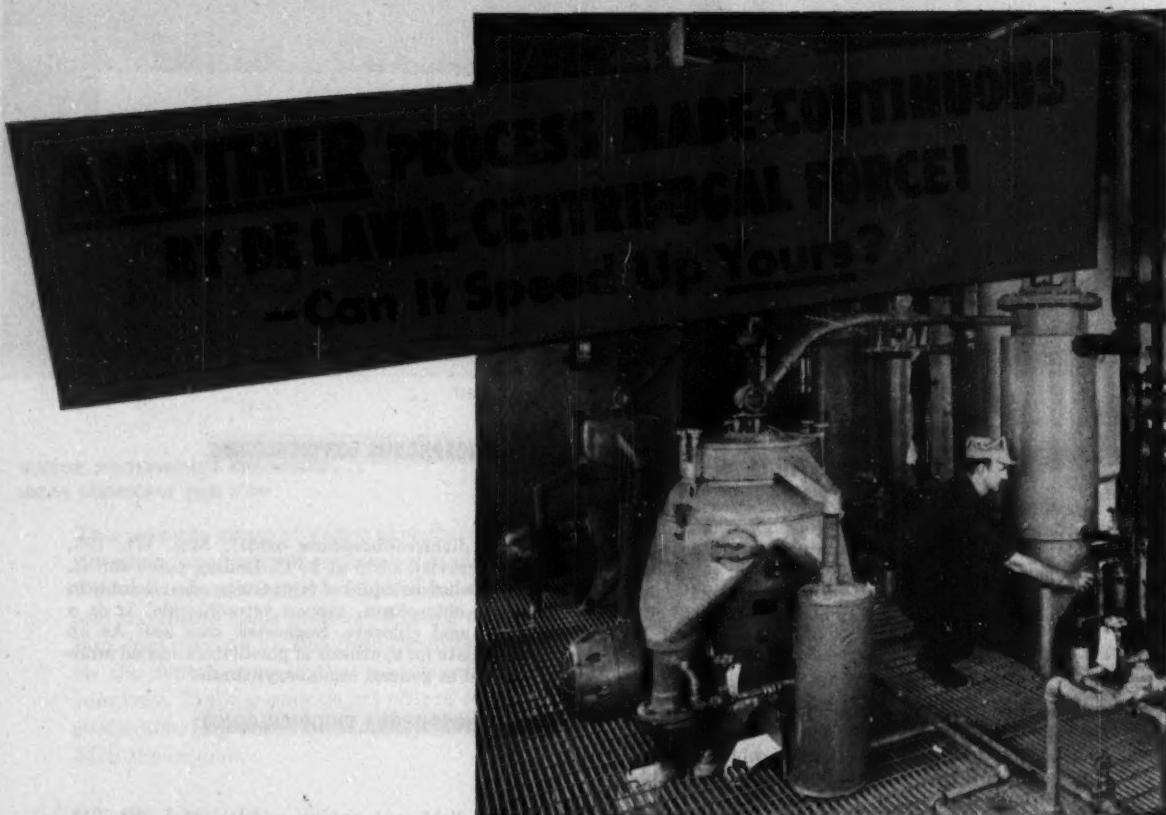


### VICTOR CHEMICAL WORKS

141 West Jackson Boulevard, Chicago 4, Illinois

A. R. Maas Chemical Co., Division

4570 Ardine Street, South Gate, Calif.



## Refining Rice Bran Oil

The production of rice bran oil can be speeded up very effectively by using De Laval centrifugals at two points in the refining process. One De Laval machine, the Soapstock Separator, removes the soap and waxes from the oil. Another type of De Laval centrifuge separates out excess alkali and other impurities.

For many years De Laval machines have been used to refine vegetable oils. Rice bran oil separation is merely a logical extension of this experience. It is one more example of how a De Laval centrifuge can save time and money by speeding up a process.

Usually, centrifugal separations are quite easy; in some cases, De Laval machines will break emulsions that are too tight to break by other means.

● Why not tell us of *your* problem.



THE DE LAVAL SEPARATOR COMPANY Chicago Poughkeepsie San Francisco

# DE LAVAL

**FOR FASTER  
PROCESSING SYSTEMS**

# Sulphur



*Thousands of tons  
mined daily,  
but where does it all go?*

**D**id you ever have the misfortune on a steaming, sticky, sultry day to sit it out on a crowded parkway, bumper to bumper, waiting for traffic to clear? No doubt your thoughts were plenty sulphurous but probably not along the lines we have in mind.

We're thinking of the mineral Sulphur and its link with the automobile. Each car accounts for a substantial poundage of Sulphur, some estimates put it at around 25 pounds for the average car. Give or take 5 pounds, it shows that a tremendous tonnage of Sulphur is needed each year to put cars, buses and trucks on the road ready to operate. And don't forget the tire and battery replacements going on every day.

Sulphur enters the automobile picture through the tires, steel sheets, plated and plastic fittings, glass, battery acid and parts, copper tubing and wiring . . . all of which call for the use of Sulphur or its compounds in connection with their manufacture.

Can you wonder that Sulphur goes into industry just about as fast as the sulphur producers of the Gulf Coast Region can get it above ground and cooled preparatory to shipment?



**Texas Gulf Sulphur Co.**

75 East 45th Street, New York 17, N. Y.



Sulphur Producing Units: Newgulf, Texas • Moss Bluff, Texas

Spindletop, Texas • Worland, Wyoming

# Teamed for tops

OUTDOOR  
SPLASHPROOF MOTOR  
BY ELLIOTT



Elliott outdoor motor in operation under spray test at factory.



**ON THE DRIVING END,** the motor that is rapidly becoming famous throughout industry for its ability to operate anywhere in the open, absolutely unprotected, quite unaffected by any climatic condition, snow, rain, sleet, fog, dust storm, heat or cold.

With the cost of housing eliminated, and location limitations thrown overboard, these big Elliott motors have turned a new page in industrial plant design and costs. Available from first size above NEMA frames and larger. Call or write your nearest Elliott District Office for consultation.

For Elliott Crocker-Wheeler industrial motors, 1-200 hp, write Elliott Company, Jeannette, Pa.

## ELLIOTT

Ridgway Division • Ridgway, Pa.

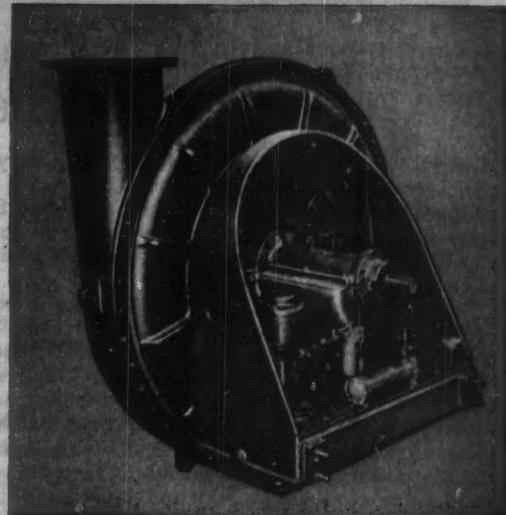
PLANTS ALSO AT: AMEREE, N.J. • SPRINGFIELD, O. • NEWARK, N.J.

# *in reliability!*

## HIGH PRESSURE CENTRIFUGAL BLOWER BY ELLIOTT

**AT THE DRIVEN END,** one of the high-pressure gas circulators that Elliott builds, for operation in a closed system, suitable for discharge pressures up to 1000 psig or more.

Elliott centrifugal blowers are custom-built to the requirements of the installation. They are characterized by unusually rugged construction throughout and several large multi-stage units have recently made some outstanding authenticated records for continuous operation and low maintenance. Built for motor drive, motor geared drive or turbine drive. Call or write your nearest Elliott District Office for consultation.



Typical Elliott single-stage blower,  
for turbine or motor drive.

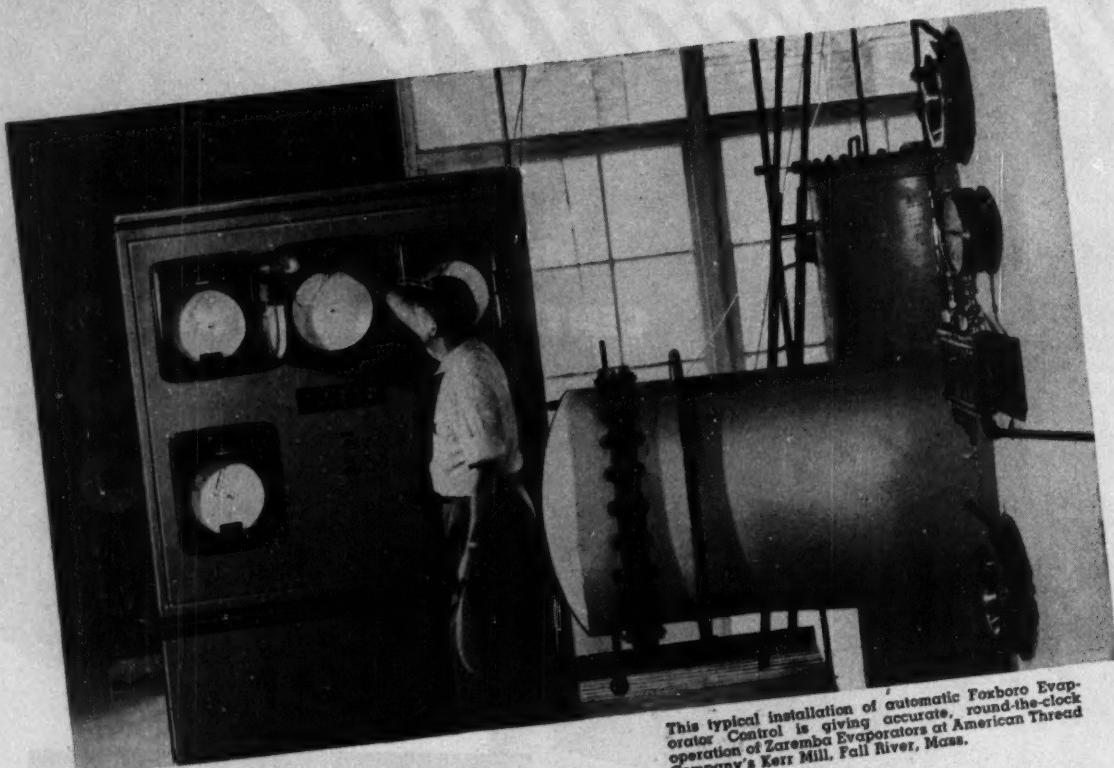
# Company

**Centrifugal Blower Dept. • Jeannette, Pa.**

DISTRICT OFFICES IN PRINCIPAL CITIES



# Control Evaporator Concentration Automatically!



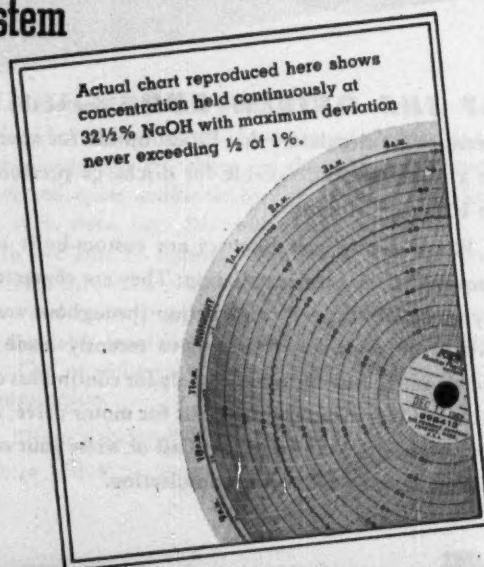
This typical installation of automatic Foxboro Evaporator Control is giving accurate, round-the-clock operation of Zaremba Evaporators at American Thread Company's Kerr Mill, Fall River, Mass.

## ...with an individually-engineered Foxboro Instrument System

In more than 40 plants throughout the country, evaporator concentration is being held at precise values, automatically, with Foxboro Control Systems. Some of these systems have been in daily use for as long as 4 years. The principles are easily and equally adaptable to virtually any polar solution.

Foxboro Automatic Evaporator Control is based on continuous measurements of "boiling point rise" . . . and on the exceptional sensitivity (1/100 of 1% of scale) of the Dynalog Electronic Controller combined with the high accuracy and stability of the Dynatherm Resistance Bulb. Pioneered and developed by Foxboro, this automatic control for evaporators offers you greater uniformity of end-product, increased evaporator capacity, elimination of spot sampling, and the release of needed manpower from purely routine tasks.

Write for engineering data sheet including full specifications and layout . . . and for a copy of the monograph "Quality Control in the Process Industries." The Foxboro Company, 383 Neponset Avenue, Foxboro, Mass., U.S.A.



# FOXBORO

Reg. U. S. Pat. Off.

AUTOMATIC EVAPORATOR CONTROL

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

# ROLLS LAST LONGER

in the  
**Sanitary**



Circle-Chill rolls, smooth or corrugated, are also available for all Allis-Chalmers roller mills and other makes as well.

## A clearly defined, uniform chill depth in Circle-Chill rolls provides maximum wear

The Extra Wear built into Circle-Chill rolls gives you a bonus of many additional months of profitable milling.

The toughness of the Circle-Chill roll is the result of a recently developed centrifugal casting technique. A wear-resistant, white iron shell is bonded to a softer gray iron core. Centrifugal casting makes possible a longer wearing milling surface with no soft gray iron permeation.

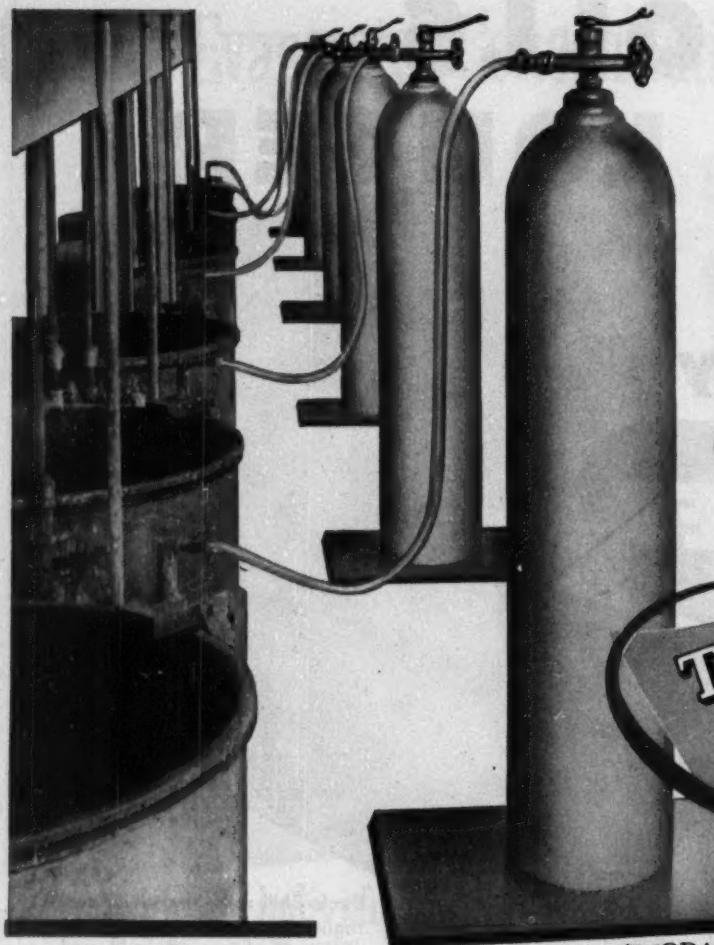
### OTHER FACTORS IN LONGER ROLLER LIFE

In the AirSet roller mill there is no uneven roller wear. Rolls wear evenly because a high speed vibrating type feeder distributes stock uniformly over rolling surfaces. Air from a single source maintains equal pressure on both ends of rolls. When feed stops, rolls open automatically to prevent destructive metal-to-metal contact. Get complete facts from your nearby A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 06B7218.

AirSet and Circle-Chill are Allis-Chalmers trademarks.

# ALLIS-CHALMERS

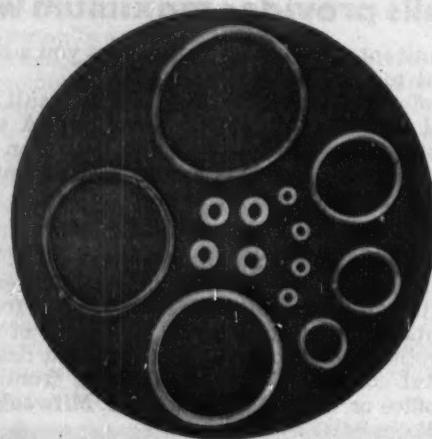




TYGON TUBING as used by the Eagle-Picher Co. to convey chlorine gas from cylinders to tanks containing metallic oxides—a truly severe test of chemical resistance.

*to*  
**CONDUCT  
CORROSIVE  
CHEMICALS**

**TYGON**  
flexible plastic  
**TUBING**



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# THE *Chementator*<sup>®</sup>

*Prepared under the direction of Joseph A. O'Connor, News Editor*

- New ethylene producers on the Gulf Coast aren't unlikely. Phillips Chemical might build an ethylene plant at Houston. And United Gas may build a plant to strip ethylene from natural gas. Demand keeps growing. Goodrich, for one, has been shopping for ethylene.
- Brush Development Co. of Cleveland, interested in growing crystals of germanium and other semiconductors, is going into the transistor business.

#### Titanium moves into process equipment

Chemical processing equipment made of titanium is fast becoming a reality. Methods of processing and fabricating titanium, especially powder metallurgy, are being worked out by Brush Development Co. of Cleveland. This work is hastening the advent of process equipment made of titanium.

Brush, for example, has produced for Fram Corp. a titanium filter for fuming red and white nitric acid. After 700 hr. in fuming nitric at 160 deg. F. the weight loss was less than 0.5 percent, contrasted with 316 stainless, the previous material, which completely dissolved after 168 hr. The Air Force is using the fuming nitric for rocket fuel.

In addition to filters for nitric acid, complete fuel systems of titanium are being developed for handling rocket fuels.

Autoclaves lined with titanium sheet are being built by Autoclave Engineers of Erie, Pa.

Brush has made titanium nozzles for handling iron sulfate slurry. Other parts made of titanium by Brush: pump impellers and valve trim. The valve trim may be competitive with monel in manufacturing costs. A nutating disk, made by Brush, is now under test at the plant of Buffalo Meter.

#### How can industry get into nuclear power?

If industry wants to invest its own money in nuclear power, it should offer clear proposals to the government. This might speed revision of the McMahon Act. Such proposals from industry undoubtedly would result in hearings to determine how industrial investment could be safeguarded by revising the act.

As it stands, the Atomic Energy Act forbids private ownership of plants that can produce enough plutonium or other fissionable material for use in an atomic bomb. Thus industry cannot own nuclear power plants producing plutonium in such volume.

If industry won't pay for civilian nuclear power

development, W. Sterling Cole, ranking Republican Congressman on the Joint Congressional Committee for Atomic Energy, feels the government should pay. But if the government is to foot the bill, Cole sees no reason why the McMahon Act should be changed.

Bourke B. Hickenlooper, ranking Republican Senator on the Joint Committee, says hearings should be held immediately to get all opinions on the record.

It appears questionable, according to Cole, that the U.S. needs more plutonium, which would be produced together with power in nuclear power plants. Expenditures that have been disclosed seem to show that the U.S. has been concentrating on production of uranium as a source of atomic energy. And at present its cost is probably less than a tenth that of plutonium.

AEC Chairman Gordon Dean feels there should be major declassification of information on power reactors. Not only would this speed reactor technology in this country, but it would improve U.S. relations with foreign suppliers of uranium. Some of these suppliers need power and if information on power reactors were declassified, the U.S. could help these nations with technical knowledge.

Both Cole and Hickenlooper likewise favor major declassification of reactor information. Hickenlooper feels that AEC has the authority right now to declassify much more than it has. He also says that AEC should stay out of civilian nuclear power and that industry should be given every encouragement.

#### Trend to earlier specialization

Future chemical engineers will begin to specialize in their senior year at Lehigh University as a result of the recent overhauling of the chemical engineering curriculum.

Big innovation, according to Dr. Alan S. Foust, the department head, is that new courses have been added to allow mild specialization by seniors in their chosen fields of chemical engineering. (Continued)

## THE CEMENTATOR, continued

In addition to design and development work, still the principal field of employment for chemical engineers, seniors will have the option of concentrating in the direction of sales engineering, plant administration, organic chemical industries, or inorganic chemical industries including atomic energy operations.

A new course in power plants and heat engines will also be added during the senior year. Chemical engineers are called upon increasingly to solve plant problems of heat and electric energy.

### Rare earths now made in India

India now has its own rare earth industry. A government-owned processing plant has been set up at Alwaye near the seaport of Cochin in Travancore. The enterprise is under the authority of the Indian Atomic Energy Commission, with technical assistance from a French company, Societe des Produits Chimiques des Terres Rares. The plant is already in production.

Each year, the plant will process 1,500 tons of monazite sand from the beaches of Travancore. Main products will be rare earth chlorides and carbonates. Thorium extraction, with production of thorium nitrate, will make possible recovery of byproduct uranium.

Discovery of monazite, a phosphate of rare earths with which thorium oxide is found, was made accidentally by a chemist, C. W. Schomberg, in 1909, and was later confirmed by the Geological Survey of India. Exports of monazite sand began soon afterward, and had reached 5,000 tons annually by 1937, just before World War II.

In 1948 Prime Minister Nehru banned exports and asked the newly set up Atomic Energy Commission to advise how best to exploit the atomic mineral resources of India. Negotiations were soon started with several companies and advice sought from the Atomic Energy Commissions of other nations. The result is India's brand new plant for processing rare earths, which has just started operating.

Travancore is rich in ilmenite, in monazite and in zircon, a silicate of zirconium. Before World War II, India furnished about 75 percent of the world's requirements of titanium dioxide from ilmenite. It's estimated that India has a reserve of 250 million tons. Reserves of monazite are estimated at 1.5 million tons, and about the same quantity of zircon.

### Makers of chemicals hold prices down

Prices in the chemical industry declined in almost every month last year, according to the Manufacturing Chemists' Association. The wholesale price index for chemicals and allied products, as compiled by the U. S. Bureau of Labor Statistics, is only 3 percent higher than before the Korean war. The index for all commodities, as distinguished from chemicals, is almost 11 percent higher than before the Korean conflict.

Chemical industry has been able to hold down price increases because of new and improved processes and because of large investments in new and more efficient plants and equipment. The industry is now mid-way through its \$6 billion expansion, slated for completion by 1955.

Competition in the industry, spurred by this new capacity, has brought sharp reductions in some chemical prices, and has held others at low levels despite higher labor and material costs.

Many prices have actually been cut back. Antibiotics, for example, have been brought down to a fraction of what they originally cost. This results from volume production. Costs of the new chemical fibers for textiles have also declined sharply.

Wage costs have increased in the chemical industry as in other manufacturing industries. Rise in average hourly earnings of workers making chemicals and allied products has been almost 16 percent since Korea.

### Diamond eyes methane chlorination

Diamond Alkali has taken a 60-day option either to purchase the stock of Belle Alkali Co. of Belle, W. Va., or to acquire the right to use the Belle process for the chlorination of methane.

Under the option agreement, Diamond will pay \$275,000 if it decides to acquire the process. If purchase is made, Diamond will pay \$1,558,300 if all outstanding shares of Belle are acquired. Belle Alkali's five controlling stockholders are parties to the option agreement.

President Raymond F. Evans of Diamond Alkali explains that the action is another expansion of Diamond's activities in organics. Three organic products—methyl chloride, methylene chloride and chloroform—are derived from the chlorination of methane, and their major uses are in the manufacture of silicone resins, drugs and solvents.

### Why Phillips switched to a centrifugal

In a radical departure from the conventional U. S. method, Phillips Chemical is using a centrifugal compressor instead of reciprocating compressors to furnish compressed air for ammonia oxidation in the new nitric acid units at the Etter, Tex., plant.

Nitric acid production at this plant, formerly the Cactus Ordnance Works and now leased from the government by Phillips, has been increased by installing two new German-made ammonia oxidation units. Installed by Chemical & Industrial Corp., each of these units can turn out 55 tons per day.

Primary difference between the new units and conventional ammonia oxidation units is that a centrifugal compressor supplies process air.

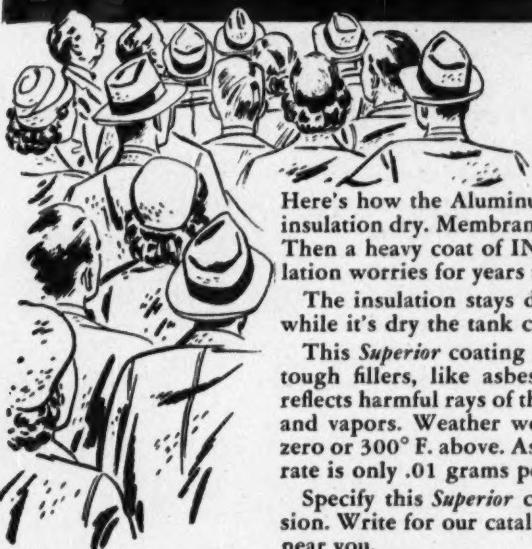
The Clark centrifugal compressor has a total of nine stages in two cases, and compresses 16,000 cfm.

(Continued on page 110)



*What's going on here?*

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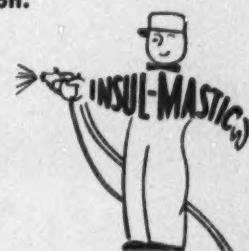
This *Superior* coating gives lasting protection because of its flexibility and its tough fillers, like asbestos, which absorbs physical abuse, and mica, which reflects harmful rays of the sun. Its large Gilsonite content resists industrial fumes and vapors. Weather won't harm INSUL-MASTIC. It will stand 40° F. below zero or 300° F. above. As for being watertight . . . its moisture vapor transmission rate is only .01 grams per 100 square inches per 24 hours per  $\frac{1}{8}$  inch.

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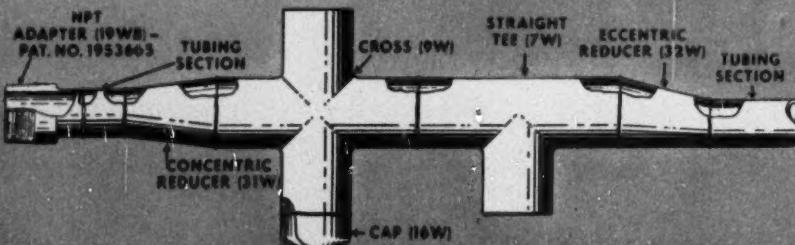
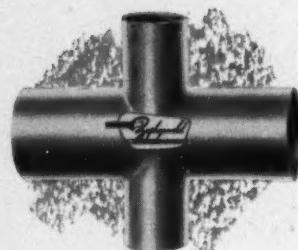
#### **ZEPHYRWELD® WELDING FITTINGS**

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\* Shown at the right is a composite drawing showing the way in which Zephyrweld fittings are assembled, by butt welding, to light gauge pipe, or to one another. All ends are square and true—no chamfering is required to accomplish fast, clean welding. Note how Zephyrweld fittings are adapted to iron pipe size fittings through use of a special adaptor.

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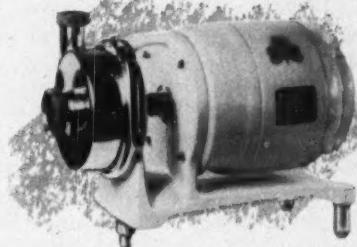
Tri-Clover sanitary fittings are widely used in processing foods and pharmaceuticals.

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## THE CHEMICALATOR, continued

of atmospheric air to 125 psi. The primary drive for this compressor is a 3,500-hp. electric motor. Additional drive is provided by a Westinghouse centrifugal expander that can deliver 1,210 hp. by utilizing the energy of the 75-psi. exit gas from the absorption columns. The centrifugal compressor and the expander are used instead of the conventional two pairs of reciprocating compressors, one pair driven by gas engine and the other by the exit gas.

Before deciding to use a centrifugal compressor, Phillips carefully analyzed the comparative economics of a centrifugal vs. reciprocating compressors. For ammonia oxidation, Phillips found, it costs less to operate a centrifugal compressor. And the initial investment is lower for the centrifugal unit.

The service factor of a centrifugal compressor should not be less than 98 percent. Ammonia oxidation units with a centrifugal air compressor should give an over-all efficiency of 93.5 percent.

With a centrifugal compressor, platinum gauze has to be changed only once every 45 days—or even less frequently sometimes. This is because the air is not contaminated with oil or iron. For the same reason, less contaminants in the air, catalyst loss is reduced by operating with a centrifugal compressor.

Another consideration in Phillips' decision to use a centrifugal compressor was the elimination of pulsations in the air supply. A pulsating air supply, such as reciprocating compressors deliver, can produce a rapid and sometimes wide variation in temperature in the combustion zone. This results in lower conversion efficiencies.

It was to take advantage of these improved operating features, as well as the lower initial investment cost, that Phillips decided to install a centrifugal compressor.

### Polyvinyl alcohol made by new process

Production of polyvinyl alcohol is currently about 15 million pounds per year, with Du Pont far and away the biggest producer. In its Niagara Falls plant, Du Pont makes polyvinyl alcohol by a continuous process, using alkaline hydrolysis.

In Cleveland, Colton Chemical is now producing polyvinyl alcohol in its new plant after two years of pilot-plant production. Colton has been selling more than 1 million pounds per year, expects to better that now.

It took Colton about five years to develop its process, which produces a non-gelling product, important for use in adhesives. Colton spent better than \$250,000 to develop the process and for its plant.

In the process, vinyl acetate monomer is polymerized to polyvinyl acetate, then hydrolyzed to polyvinyl alcohol. Like Du Pont, Colton uses alkaline hydrolysis.

The product is fully hydrolyzed. Colton makes two

grades, one with a medium viscosity of 20 to 30 cps. and the other with a high viscosity of 35 to 50 cps.

American Resinous Chemicals of Peabody, Mass., also makes polyvinyl alcohol. So does Shawinigan Resins Corp. of Springfield, Mass., at its Indian Orchard, Mass., plant. Shawinigan Resins uses acid hydrolysis, and its product goes to Shawinigan Products Corp. and Monsanto. At Texas City, Monsanto has also produced polyvinyl alcohol experimentally.

Polyvinyl alcohol is used in the adhesive, textile and paper industries. It is used as an emulsifying agent. A growing market is in synthetic fibers, such as nylon, where it is used as a size.

Vinyl acetate monomer is the principal raw material for the production of polyvinyl alcohol. About 105 million pounds of vinyl acetate monomer are made per year, with Carbide & Carbon at Niagara Falls the principal producer.

DuPont also makes vinyl acetate monomer for its own use. In Canada, Shawinigan Chemicals, Ltd., makes it, mostly for its own use, with some going to Shawinigan Resins for its Indian Orchard, Mass., plant. Shawinigan Chemicals likewise markets vinyl acetate monomer in Canada, as does Shawinigan Products in the United States. Monsanto will begin making vinyl acetate monomer in its Texas City plant this year.

About 5 lb. of vinyl acetate monomer goes into the production of every auto. It's used to make polyvinyl butyral for safety glass.

Polyvinyl acetate in solid, solution and emulsion form is made by Colton Chemical at its Cleveland plant. So production of polyvinyl alcohol by its new process was a natural for Colton.

### New way to sulfonate organics

Tennessee Corp. is now producing an alkyl aryl sulfonate detergent by a new continuous process at its Copperhill, Tenn., plant. Advantages of its process, according to Tennessee Corp., are specially designed equipment and unique raw materials.

These raw materials, other than the organics to be sulfonated, come from the sulfuric acid plant at Copperhill. Most processes use oleum.

The process results in essentially complete sulfonation, with 1 percent or less of the organics left unreacted. The product contains close to 90 percent of active ingredient, and only about 10 percent sodium sulfate.

Because of its low sodium sulfate content, the finished detergent can be used in builders. It is stable in both acid and alkaline solutions, and will work in water with a hardness up to 300 ppm. The high-purity product foams readily. Tennessee Corp. supplies it as dry flakes or as an aqueous slurry.

At present, the product is a sodium salt, but  
(Continued on page 112)

# Small CLEVELANDS provide wide range of stroking speeds for Milton Roy pumps

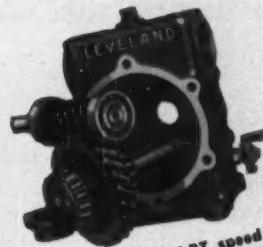
THIS Milton Roy controlled volume pump meters 3 liquids in exact ratio—fatty acid, sulphuric acid, and glycerin, delivered at differing speeds.

To provide the variation of stroking speeds necessary and to insure accurate control of proportioning and volume, the pump builder uses three small Cleveland worm gear reducers with a variable speed motor.

Cleveland worm gear units take up a minimum of space. They transmit power with a smooth, uniform torque flow. Case-hardened steel worms mesh with nickel-bronze gears for long, hard, dependable service without appreciable wear. Throughout the chemical and allied industries, you'll find Cleveland—big and small—driving pumps, agitators, mixers—in fact, every kind of equipment for which a right-angle drive is needed.

If you have a power transmission problem, you can get help by writing for Catalog 400. The Cleveland Worm & Gear Company, 3273 East 80th St., Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.



Three Cleveland 10 RT speed reducers (with 3" centers) on a six cylinder gang pump installed in a California oil plant. Two at 88 strokes per minute, drive pumps at 70 strokes per minute, the third at 70 strokes per minute. Photo by courtesy of Milton Roy Company.



## THE CHEMICALATOR, continued

soon the detergent will also be offered as the potassium, ammonium or alkanol-ammonium salt. Production of heavy metal salts, such as calcium and barium, used in oil solvents, is planned for the future.

In addition to the manufacture of alkyl aryl sulfonates, the new continuous process of Tennessee Corp. can be used to make both benzene and toluene sulfonic acid and other sulfonated products. The new unit at Copperhill has been designed so that it can sulfonate materials for use in plastics and pharmaceuticals as well as detergents.

### Another sulfonation plant for Conoco

Expanding its activities in petrochemicals, Continental Oil Co. has acquired Bryton Chemical Co. of Trainer, Pa., one of the first producers of synthetic oil-soluble sulfonates.

Conoco is already one of the largest producers of industrial synthetic detergents in the Midwest, operating a sulfonation plant in Chicago. Synthetic detergents made at the Chicago plant are all of the water-soluble type, while the sulfonates produced at the Bryton installation are soluble in oil.

When completed, Continental's current expansion of its Baltimore, Md., petrochemical plant will triple capacity there. The Baltimore plant makes raw materials for alkyl aryl sulfonates of both the water-soluble and oil-soluble types. It will supply basic raw materials for the two sulfonation plants at Chicago and Trainer, Pa.

### New producer of triple superphosphate

Davison Chemical is going into the triple superphosphate business. As part of its current \$25.4 million expansion program, Davison is building a \$12,410,000 plant at Bartow, Fla., to make triple super. When the plant starts operating early in 1954, it will be able to turn out 200,000 tons a year. The Davison plant is the largest being built in the current \$35 million construction effort of Florida's phosphate industry.

This will be the first triple superphosphate plant in the United States to use the Dorr process. Sulfuric acid is reacted with phosphate rock to produce phosphoric acid, which in turn is reacted with more phosphate rock to get the triple superphosphate. Both granulated and pulverized triple super will be produced.

Sulfuric acid will be made in a contact unit with a daily capacity of 550 tons. The plant will have sulfur storage facilities and silos that can hold 1,000 tons of phosphate rock.

The new Bartow plant will make Davison a major producer of triple superphosphate. Total capacity of the industry at present is estimated at 770,000 tons a year. By 1954, Davison's output added to other new

and expanded operations will bring the industry's total estimated capacity to more than 1 million tons annually. Even so, demand by the end of that year, according to the U.S. Department of Agriculture, is expected to reach 1.6 million tons.

### Record climb for latex paints

The U.S. paint industry, according to N. R. Peterson of Dow, last year made and sold 35 million gallons of latex paint. This volume was achieved in five years. The paint industry, Peterson told CCDA members in Cleveland, has never participated in a development that has moved as fast as latex paints.

Latex paints are an offshoot of the wartime development of synthetic rubber. Most styrene-butadiene copolymers used in synthetic rubber contain 50 percent or less of styrene. But Dow early directed part of its research toward high-styrene copolymers for uses other than synthetic rubber. Dr. L. L. Ryden of Dow pioneered in the development of these styrene-butadiene latices. It was found that a copolymer containing 60 percent styrene is best.

Dow wisely concentrated on developing this latex as a water paint vehicle. It can also be used as an adhesive for coating paper and as a textile coating.

In 1946 field development was begun in the paper, textile and paint industries. Latex caught on first in the textile industry. By the end of 1946 the textile industry was using carloads, and by mid-1947 so was the paper industry.

But latex paints did not catch on as fast as the paper and textile coatings. Glidden was the first in the paint industry to sense the potential of latex paints. Field trials of latex paint in the fall of 1947 provided the ammunition for an all-out campaign in 1948 to put over the radically new paint.

Since then, consumer demand for latex paints has snowballed steadily. In 1948, 100,000 gal. of latex paint was sold; in 1949, 2 million gallons; in 1950, 3.5 million; in 1951, 30 million; and in 1952, 35 million gallons.

### California gets a new ammonia plant

Brea Chemicals, Inc., newly organized subsidiary of Union Oil Co. of California, will lease and operate a specially designed \$13 million plant to be built at Brea, Calif., for the manufacture of ammonia for the West's agriculture and industry.

Ammonia will be made from natural gas taken from wells near Brea.

Amoniaco Corp., a non-affiliated company, will finance the plant's construction. C. F. Braun & Co. has been picked by Amoniaco to build the plant on a 30-acre site two miles east of Brea. Annual payroll will come to \$750,000 when the plant starts operating in the summer of 1954.

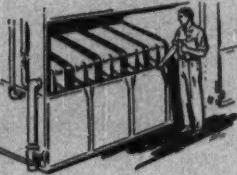
What's Happening, turn to page 114

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# What's Happening

## FEATURE NEWS

Acrylic Monomers .....	114
Industrial Research .....	116
Tankcar Cleaning .....	118
Bagged Bacteria .....	120
Lignin Recovery .....	122
Giant Al Pots .....	128
Liquid Oxygen Unit .....	138

## Hanna to Make Ferronickel By Ugine Process for DMPA

Government agreements with two subsidiaries of M. A. Hanna Co. of Cleveland for the mining and smelting of nickel ores from Oregon's Nickel Mountain will boost the nation's supply of critical ferronickel. The deal with the Defense Materials Procurement Administration calls for Hanna to produce 95 million to 125 million pounds of nickel as ferronickel. Hanna will use the French Ugine process.

Fast tax writeoffs have been granted on 85 percent of the \$3.6 million mine and on 70 percent of the smelter.

According to the agreements with DMPA, Hanna Coal & Ore Corp. will mine and sell to the government enough ore to produce a minimum of 95 million pounds of nickel contained in ferronickel. The price will be \$6 per dry ton of ore with a nickel content of 1.5 percent.

The deal with Hanna Nickel Smelting Co., the other subsidiary, calls for the government to advance up to \$24.8 million for construction of the smelter. Ore will be converted to ferronickel ingots at a cost to the government not exceeding 79.39 c. per lb. for the first 5 million pounds and 60.5 c. thereafter, exclusive of the amortization of facilities. Hanna Nickel Smelting will pay the government the same price for the ore that the United States pays to Hanna Coal & Ore Co.



HCN and cyanohydrin units were the first built at Deer Park in 1947-48.

## New Process for Acrylics

Rohm & Haas' new plant makes acrylic monomers directly from acetylene and carbon monoxide, supplanting older processes based on ethylene derivatives.

Acetylene has won the latest round in its battle with ethylene as basic material for synthetic organic chemicals. Rohm & Haas has recently started up at Deer Park, near Houston, Tex., a new \$8-million plant for making acrylic monomers from acetylene. The older unit, which used ethylene derivatives, has been shut down.

The new process permits significant price reductions. Methyl acrylate monomer has been reduced from 49 c. to 42 c. per lb. in tankcar quantities; the ethyl monomer has come down from 48 c. to 42.

Rohm & Haas is convinced that the market for acrylic monomers can be widened by lower prices. Fond hopes are pinned on the future of acrylic dispersions in water-base paints. Another potentially big market is in soil stabilizers and conditioners.

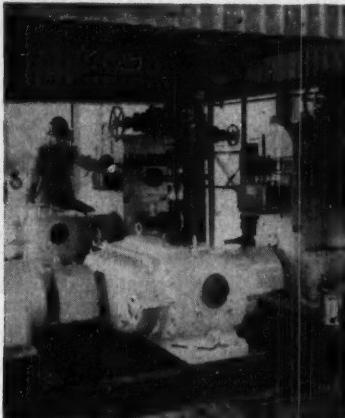
► New Process—The new Texas plant

uses a process first studied by Dr. Walter Reppe in Germany.

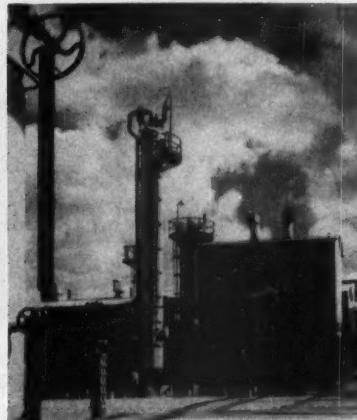
Reppe found that acrylic esters could be made by the interaction of nickel carbonyl with acetylene and an alcohol under mild conditions of temperature and pressure. However, the reaction requires stoichiometric quantities of the carbonyl and product yield is only about 60 percent. Under more severe conditions—150 to 180 deg. C. and 30 atm. pressure—Reppe found that carbon monoxide itself would react with acetylene and an alcohol in the presence of a catalyst such as nickel bromide. In this process there would be no need for recovery of nickel and reconversion to the carbonyl.

But this process had its disadvantages, too. Among other things, the reaction is too slow; catalyst is lost by volatilization and decomposition;

# in Chemical Engineering



FEED pumps for nickel carbonyl unit.



CARBON monoxide production unit.

the acrylates tend to polymerize; acetylene forms tars which foul up the catalyst; handling of acetylene at this pressure is hazardous.

► **Happy Medium**—Rohm & Haas researchers hit upon a compromise process which uses mild conditions and is fast, yet consumes only 20 to 40 percent of the nickel carbonyl required by the stoichiometric process.\* The trick is to start the reaction with nickel carbonyl, then feed in carbon monoxide. The process runs at atmospheric pressure with temperatures in the range of 30 to 50 deg. C. Yields are in the range of 80 to 90 percent, based on acetylene and total carbon monoxide.

According to R & H, the process is readily adaptable to continuous operation; in fact, present operations are already on a continuous basis.

► **Exit Ethylene**—Production of acrylates, up until now, has been based on ethylene. Rohm & Haas' first pilot plant, built at Bristol, Pa., in 1931, used ethylene chlorohydrin and sodium cyanide. Seeking lower costs, R & H next went to a process involv-

ing the reaction of ethylene oxide and hydrogen cyanide, with the HCN being generated from purchased sodium cyanide.

In an effort to reduce costs still further, R & H decided to make its own HCN from methane and ammonia. This decision resulted in the construction in 1948 of an \$8-million HCN plant at Deer Park.

The new acetylene-based process uses neither ethylene oxide (or chlorohydrin) nor HCN. Manufacture of methacrylates, however, is still based on acetone and HCN.

Next logical step for R & H, as soon as the volume justifies it, would be production of its own acetylene from natural gas. Acetylene is now generated from purchased calcium carbide.

► **Smart Engineering**—Basic data for design of the new plant were obtained from a bench-scale unit operated under carefully controlled laboratory conditions. Conventional pilot-plant-scale tests were bypassed. Performance of the Deer Park plant, however, has been highly satisfactory as to throughput, yields and purity of products.

R & H engineers had little definite

data to go on as to the toxicity of nickel carbonyl. Thorough investigation during the process development work resulted in the design of an automatic detector system in the new plant, which sounds an alarm if a dangerous concentration of nickel carbonyl is reached.

► **Big-League Markets**—Acrylics already are large-volume chemicals, since Rohm & Haas has been producing several million lb. per year by the older process. They have been widely used in plastics and in leather and textile finishes. They also go into special synthetic rubbers, lubricating oil additives, adhesives and in chemically resistant color-fast lacquers. Many of these uses, however, have been largely regarded as specialties which can stand relatively high prices.

The company now has developed a new product tailor-made for use in high-quality water-base paints. This product, a 100-percent acrylic dispersion in water, is said to offer many important advantages over existing vehicles. Although it's more expensive than competing dispersions, R & H expects the advantages of simpler formulations and improved quality to more than offset the difference.

## **Esso Adds Unit at Bayway For Distilling Crude**

Increasing the capacity of its Bayway, N. J., refinery, largest on the East Coast, Esso Standard Oil Co. is adding a crude distillation unit that can handle 60,000 bbl. per day. M. W. Kellogg Co. will build the new unit.

A three-stage plant, the unit will be similar in design to two units now being built by Kellogg at Esso's Baton Rouge refinery. Engineering is now under way on the unit for the Bayway refinery, and construction will start early this summer.

\*U. S. Patent 2,582,911.

	<b>Chemical &amp; Allied Industries</b>	<b>All Manufacturing Industries</b>
<b>COST:</b>	<b>\$204,170,000 . . . . .</b>	<b>\$1,613,493,000</b>
2½% of gross sales . . . . .		<b>2%</b>
\$16,500 per research scientist . . .		<b>\$22,700</b>
\$ 7,900 per research worker . . . . .		<b>\$9,000</b>
<b>WAS GOVERNMENT FINANCED:</b>		
7.1% of research . . . . .		<b>46.5%</b>
<b>EMPLOYED:</b>	<b>13,181 engineers &amp; scientists . . .</b>	<b>89,851</b>
<b>TURNOVER:</b>	<b>13.8 employees per 100 (military separations, job switches) . . .</b>	<b>16.2</b>

RDB & BLS, 1951

## How's Industrial Research?

**Booming. Bullish. Brash. Highest research expenditures in history have been recorded. Chief problem seems to be holding good men.**

Over \$3.5 billion went into research and development last year, four times the expenditure at the beginning of World War II. Aware of this prodigious research volume, the Defense Dept.'s Research and Development Board and the Bureau of Labor Statistics have just completed a survey of private industry's research effort.

Walter G. Whitman, chairman of RDB, in releasing the survey report pointed out that two-thirds of the sum was put to work in the laboratories of private industry.

► **Thank The Taxpayers**—Almost half of industry's research, however, was financed by the Federal government, principally the Department of Defense and the Atomic Energy Commission. The chemical industry wasn't typical, though. Only 7.1 percent of its research was government financed. The petroleum industry was even lower with 3.1 percent, while the aircraft industry was high with 85 percent.

Altogether, 1,934 companies responded to the RDB survey, 85 percent of the total. These employed nearly 94,000 research engineers and scientists in January 1952. More than half of the 94,000 were working for three industrial groups—electrical machinery, aircraft and chemicals. The chemical industry employed 13,181 of these men, electrical machinery added up 17,243 and aircraft came up with 20,166 researchers.

► **Scientists-Technicians**—Total research staffs, including both professional and supporting personnel, numbered 234,000. The average ratio of supporting personnel to engineers and scientists was 1.5. In the chemical industry the ratio was 0.9 supporting personnel to each scientist; the petroleum industry hit the average 1.5.

► **How Much?**—The cost of research during 1951 amounted to 2 percent of the total value of the sales and services of the 1,934 responding companies. The percentages varied widely among industries, ranging from 13 percent in aircraft manufacturing and 6 percent in electrical machinery and scientific instruments, to 0.6 percent in petroleum refining. The chemical industry spent 2.5 percent of its gross sales for research.

► **Researcher Expenditure:** \$22,700—Average research cost per research scientist or engineer was \$22,700 in 1951. Highest cost was borne by the motor vehicle industry with \$68,600 per man; the lowest was the chemical industry's \$16,500. Small companies with fewer than five research engineers and scientists averaged only \$15,400 per professional worker, compared with \$25,000 for those having professional research staffs of 1,000 or more.

Wide differences among industries were due primarily to the varying ratios of engineers and scientists to supporting personnel. This ratio varied

in most cases from 0.7 to less than 2.0. The chemical industry was slightly on the low side with its 0.9 supporting members per research scientist, while the motor vehicles industry was high and irregular with 5.2.

Taking all research employees into account, including supporting personnel as well as engineers and scientists, average cost per research worker in manufacturing was \$9,000. On this basis of total research employees the spread of average costs per employee was much smaller between industries. High was \$15,500 for transportation equipment other than aircraft and motor vehicles; low was registered by stone, clay and glass products with \$6,600.

► **Too Much Job-Hopping**—The rate of job-hopping among engineers and scientists during the last two years has become a serious situation, according to the survey report—as serious as it was during World War II.

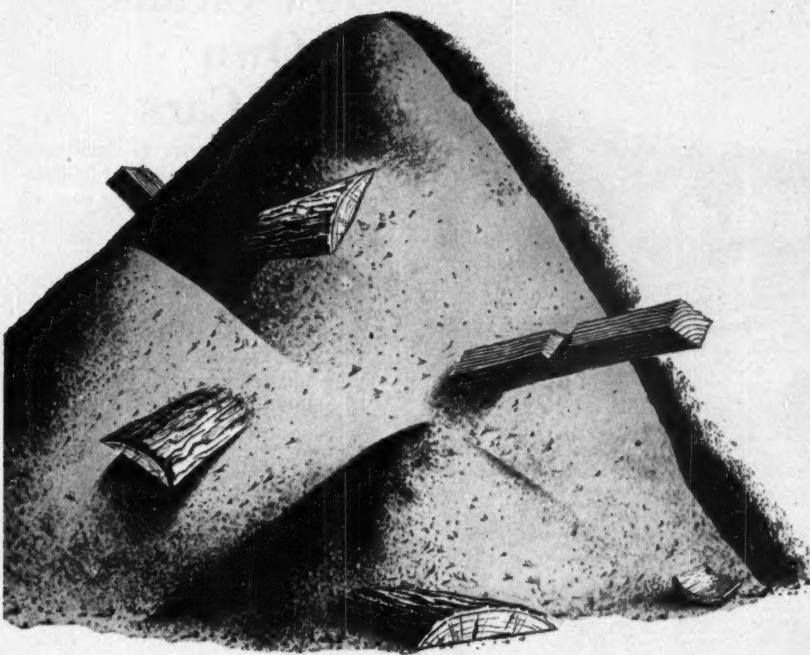
The number of research engineers and scientists who left the reporting companies during 1951 averaged 16.4 per 100 employed at the end of the year. In most industries, the separation rate was fairly close to this average. However, petroleum reported a low of only 8.8 per 100. Chemicals came off with 13.8.

Administrators in charge of research programs essential to the defense effort have reported increasing personnel losses, due to call-ups of Reservists and draftees and also to the many attractive employment opportunities open to engineers and scientists. They also emphasize that manpower shortages in these professions make replacements difficult to locate and that, at best, training of new men is a time-consuming and wasteful process.

There was no consistent relationship between the rate of personnel turn-over and the size of a company's research program. In some industries, the companies with the smallest staffs had the highest rate of personnel loss. However, in other industries, the medium-sized and large companies fared worse than the small ones.

► **Don't Blame the Military**—Call-ups for military service caused less than a fifth of all the separations of research engineers and scientists. The annual rate of separations for military service was only 3.0. Reserve calls accounted for 1.8 separations per 100 workers; Selective Service for the other 1.2.

## Uses of RCI Products



### Now Man Can Move Mountains ...of Wood Waste!

From useless to useful, that's the story of wood waste.

Among the important new developments in this field is the use of sawdust, planer shavings and other millwork waste to produce resin-bonded board.

To companies already manufacturing chipboard or dry process hardboard—and to those contemplating the manufacture of such products—here is a suggestion. Check Reichhold Chemicals, the world's largest producer of synthetic resins. RCI can provide you with expert technical counsel plus a complete line of quality resins job-tailored to your specific needs.

And remember, too, that besides its world leadership in the manufacture of today's synthetic resins with their variety of applications, RCI is also a major producer of chemical colors, phenol, glycerine, phthalic anhydride, maleic anhydride, sodium sulfate and sodium sulfite.

**REICHOLD CHEMICALS, INC.**  
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*Creative Chemistry . . . Your Partner in Progress*

# REICHOLD

CHEMICAL ENGINEERING—April 1953

**BRAKE LININGS:** PLYOPHEN powdered phenolic resins.

**CANVAS, PAPER AND GLASS CLOTH LAMINATES:** PLYOPHEN cresol, phenolic and resorcinol-formaldehyde resins and varnishes; LAMINITE polyester resins.

**CASTINGS:** FOUNDREZ powdered phenolic resins (for the shell molding process); FOUNDREZ liquid phenolic resins and FOUNDREZ core oils (for core binders).

**FURNITURE, PLYWOOD, FLOORING, HARDWOOD AND CHIPBOARD:** HYDROPHEN phenolic glues; PLYACIEN protein glues; PLYAMINE urea-formaldehyde glues; PLYOPHEN phenolic and resorcinol-formaldehyde glues.

**GRINDING WHEELS:** PLYOPHEN powdered phenolic resins.

**INSULATION:** PLYOPHEN liquid phenolic resins (for binding fibre glass and rock wool batts).

**MOLDING COMPOUNDS:** PLYOPHEN powdered phenolic resins.

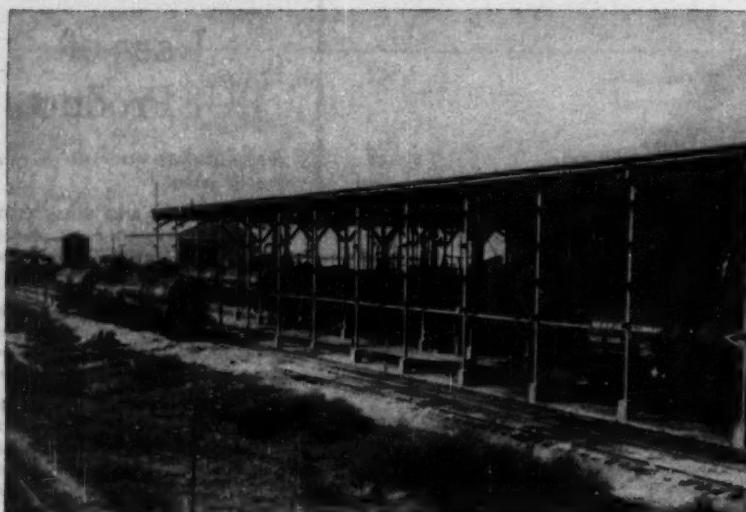
**PAINTS, VARNISHES AND LACQUERS:** BECKACITE (1) fumaric, (2) maleic and (3) modified phenolic resins; BECKAMINE urea-formaldehyde resins; BECKOLIN synthetic oils; BECKOPOL modified phenolic resins; BECKOSOL (1) phenolated, (2) phthalic-free, (3) rosin modified, (4) pure drying and (5) pure non-drying alkyd resins; KOPOL processed Congo copals; PENTACITE pentaerythritol resins; STYRESOL styrenated alkyd resins; SUPERBECKACITE pure phenolic resins; SYNTHECOPAL ester gums; WALLKYD pure drying alkyd resins (for alkyd flat wall vehicles); WALLPOL vinyl-type copolymer latex emulsions (for latex flat wall coatings); RCI inorganic chemical pigment colors.

**PAPER:** BECKAMINE urea-formaldehyde resins (for adding wet strength, improving the wet rub of starch-clay coatings, and waterproofing starch adhesives); RCI inorganic chemical pigment colors (for paper coloring); STYRESOL styrenated alkyd resins (for paper coating).

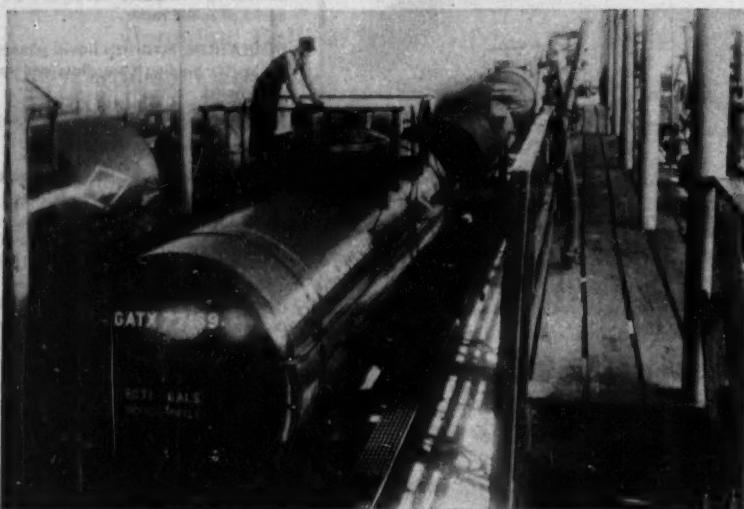
**PRINTING INKS:** BECKACITE fumaric, maleic and modified phenolic resins; BECKOLIN synthetic oils; BECKOPOL modified phenolic resins; RCI inorganic chemical pigment colors.

**TEXTILES:** FABREZ urea-formaldehyde resins (for crush-proofing and dimensional stabilization).





Tank cars approach the shed . . .



cleaned inside . . .



then returned to service.

## Dow Cleans Its Own Tank Cars

Dow figures it pays to clean your own tank cars. At present, at its Freeport, Tex., works, Dow ships over 45 products to its customers throughout the country in over 1,500 tank cars. Although it owns only 132 of the cars Dow cleans and maintains them all.

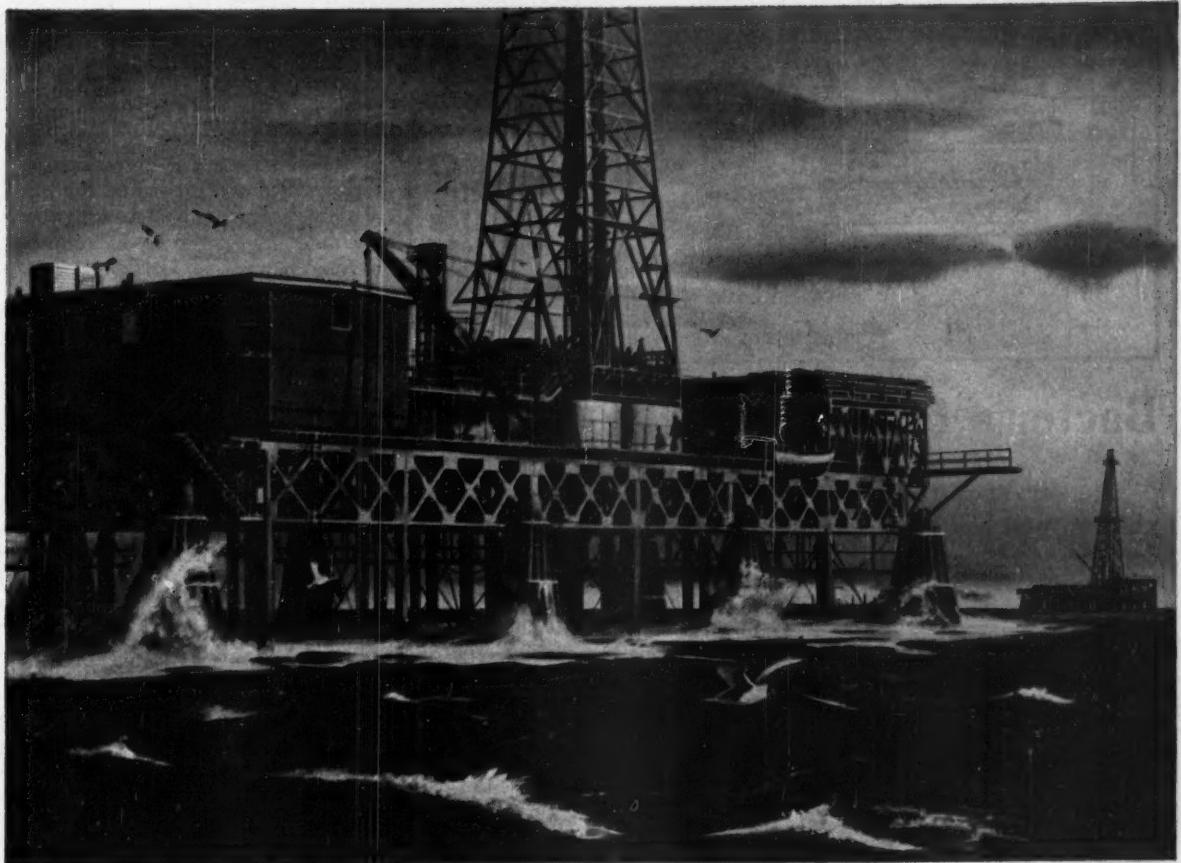
Services include cleaning, small repairs, sand blasting and painting, and lining tank interiors with vinyl plastic. Normally, the cleaning department, which operates on a 24-hr. day, seven days a week, can handle about 50 tank cars each day. Most of these cars are ordinary steel; some are aluminum; others are steel lined with Saran rubber, natural rubber, vinyl or baked phenolics to prevent contamination.

► Under a Shed—When a contaminated tank car rolls into the service shed at Freeport, it can enter any of five tracks. There is a sixth track, but this is for repairs only. On the five tracks, there are 20 cleaning stations. At any one of these stations, the car can be cleaned, according to its needs, with hot or cold water, high-pressure water, steam, compressed hot or unheated dry air.

For example, a car may be steamed until free of all vapors and odors, then washed and cooled with high-pressure water. A worker may then go over it with a wire brush, and washing with cold water would follow to remove the scrapings. Hot air may be used next to dry the surface, and finally any dirt could be removed with a vacuum cleaner. In the ordinary job, 85 percent of the cleaning is done on the inside of the tank, and the whole cleaning takes from 4 to 8 hr.

If the car is contaminated with poisonous products, it can be run onto a track on the outside of the shed for special cleaning. For safety purposes, the cleaning racks here are equipped with a special disposal system for handling toxic products.

A separate shed is used for painting operations. A car entering here is usually sand-blasted first, then coated with a primer and two finishing coats, stenciled, and sent on its way. The entire operation takes a day. Dow paints its cars primarily to keep up their appearance.



## OVER OR UNDER...LAND OR SEA...BROWN & ROOT'S EXPERIENCE CAN SAVE YOU MONEY . . . TIME!

Four decades of diversified experience in heavy construction and engineering has developed a "know-how" for Brown & Root which can be invaluable to you. Over the years Brown & Root's technological developments have provided important savings of time and money for many clients.

Regardless of your interest, be it in finished products—fabricated parts or basic

materials Brown & Root can help you. Centralized responsibility coordinates engineering and construction. This plus loyal personnel will save your firm time . . . money.

If your company contemplates new construction or plant expansion a call from you will place Brown & Root plant planning experts at your disposal.

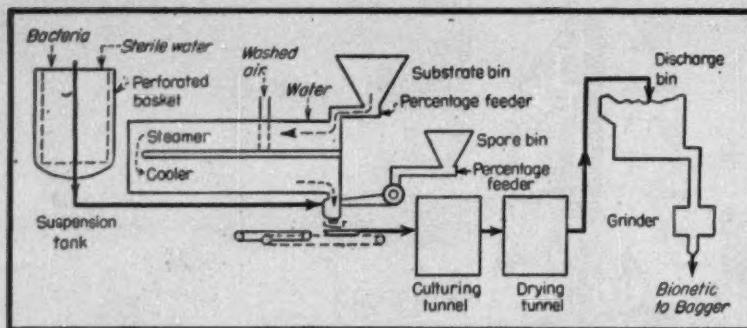


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## Bacteria by the Bagful

**By speeding biological action in industrial waste plants, powdered bacteria—available in packages—ups capacity and cuts costs.**

You can now use a dry powder instead of new construction to enlarge the capacity of waste treatment plants. The powder accelerates biological processes in plants seeded with it.

This material consists of enzymes and groups of preserved living microorganisms from natural sources. Once fed to a treatment plant, the enzymes and the organisms, via their life processes, go to work on the waste. More enzymes are produced and organisms reproduce. Synergism and biocatalytic action play a large part in making the powder effective.

Called Bionetic, it is available in a variety of formulations, each designed for a specific type of plant: trickling filters, lagoons, activated sludge digesters, Hays and Imhoff plants. It is manufactured and sold exclusively by Reliance Chemicals Corp., Houston, Tex.

Treatment of industrial wastes promises an even greater market for Bionetic than work on sanitary sewage. Already among the industrial purchasers are Standard Oil of Indiana, Carbide & Carbon Chemicals at Texas City, Shell Oil Co. at Houston, Houston Lighting and Power Co., Trunkline Gas Co., Transcontinental Gas Transmission Co. Some of these companies are already utilizing Bionetic for septic tank treatment, others are studying its possibilities.

► **Cuts Capital Costs**—Men who have spent years in the field realize that a biologically active agent such as Bionetic can reduce the capital cost of plants materially. For instance, many

wastes can be treated biologically in simple lagoons, provided there is sufficient area to do so. Bionetic can accelerate biological action in the lagoons and reduce the necessary area. However, each case is specific to the industry and the watercourse to which the effluent would ultimately go.

Another economical feature of Bionetic, according to Reliance, is that after the first big dose, smaller amounts will maintain the desired level of activity. Since the organisms in Bionetic reproduce themselves, the small addition maintains a maximum number to keep the plant in its most favorable biological balance.

Population increases or plant expansions can be taken care of, in many cases with no new investment. Increased waste loads that would have required new investments from \$35,000 to \$100,000 have been cared for, says Reliance, through the use of Bionetic at a prorated daily charge varying from \$3 to \$10 a day.

One Imhoff plant designed for the City of Houston to handle a half million gal. of sewage a day is now, with the help of Bionetic, coping with 3 million gal. For every 30-day period, 12 lb. of the powder are applied and the rate there would be 40 c. a day. This contrasts with \$2,500 a year which the city had originally planned to spend to alleviate the plant's nuisance characteristics.

**Packaged Magic**—Bionetic is packaged in 25, 50, or 100-lb. drums. It sells at around \$3.20 a lb. The powder is stable and will remain viable for

years, stored under normal warehousing conditions.

To make Bionetic a culture is grown which, after maturation, is suspended in sterile water. The suspension is then agitated and sprayed on the top of a dry substrate as a media for growing the culture. The media consists of various types of agricultural residues, with phosphates and other mineral supplements to supply complete nutrition.

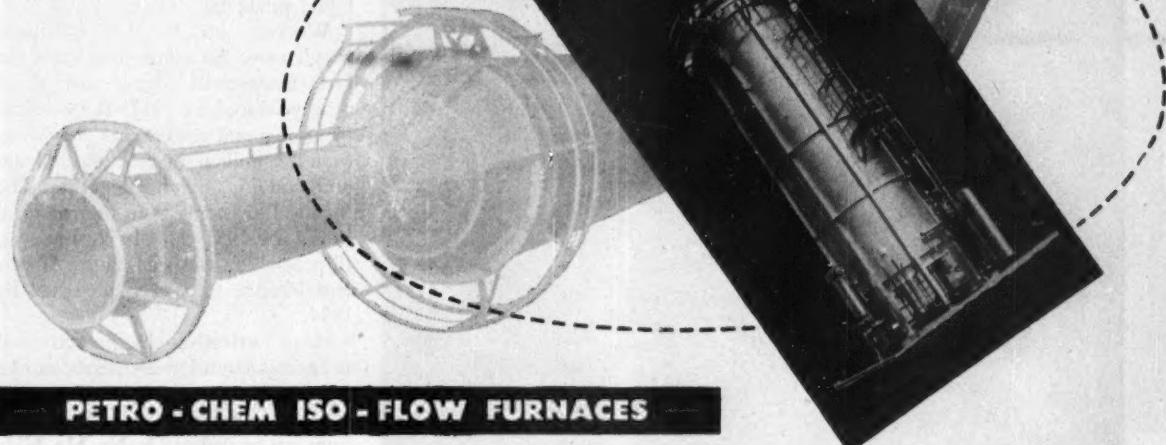
The media on a culture tray moves through a tunnel where optimum conditions are provided for growth of mixed groups of organisms. After the incubation period is completed—between 24 and 30 hr.—the culture tray travels through a drying tunnel whose maximum temperature is 110 deg. F.

The idea of application of such a product is the work of A. J. Krell, now general manager of Reliance. He conceived it while trying to develop biological waste treatment processes for removal of pollutants from industrial wastes.

The process for making Bionetic is the work of George A. Jeffreys, who originally developed it as means of providing nutritional additives to animal feeds and biochemical process applications. Jeffreys has licensed it exclusively to Krell in the field of sewage and industrial waste treatment.

► **Many-Faced Future**—Other possible uses of Bionetic are in the field of petroleum production and mineral development. Bacterial action can influence the formation of gases from petroleum hydrocarbons and change the surface tension characteristics between the oil-water-sand interface. It is possible to increase bottom hole pressure and aid in the release of petroleum from oil-bearing sands. There has long been a theory of geochemists and paleontologists that the formation of sulphur domes in the Gulf Coast has been based on the reduction of calcium sulphate through bacterial action. The rate of formation of sulphur is believed to be fairly rapid through the use of these organisms. Whether or not it would be commercially feasible to inoculate existing sulphur domes and wait for the formation of sulphur in the realizable future is an unknown quantity at this time. However, a program for inoculation of domes along the Gulf Coast is imminent.

*anyway you* **LOOK at it!**



**PETRO - CHEM ISO - FLOW FURNACES**

**are most efficient by any comparison!**

**maximum fuel efficiency**



The generic design of ISO-FLOW heaters, including the reradiating cone, gives excellent heat distribution, eliminating localized overheating. Further, all walls are protected by tubes which create low wall temperatures. The walls have high insulating characteristics which create minimum outside shell temperatures, and, hence, extremely low radiation. With a radiation loss of under 2%, more heat is absorbed by the fluid being heated, resulting in higher efficiency for any type of Iso-Flow design. Since Petro-Chem has a wide variety of convection sections, all heaters can be designed for optimum fuel efficiency or for maximum fuel efficiency where the price of fuel and other economic considerations justify.

More than 1100 are in operation throughout the world in the petroleum, chemical and allied industries . . . for all processes and for any duty, pressure, temperature and efficiency . . . and all Petro-Chem Iso-Flow Furnaces are pre-eminently satisfactory.

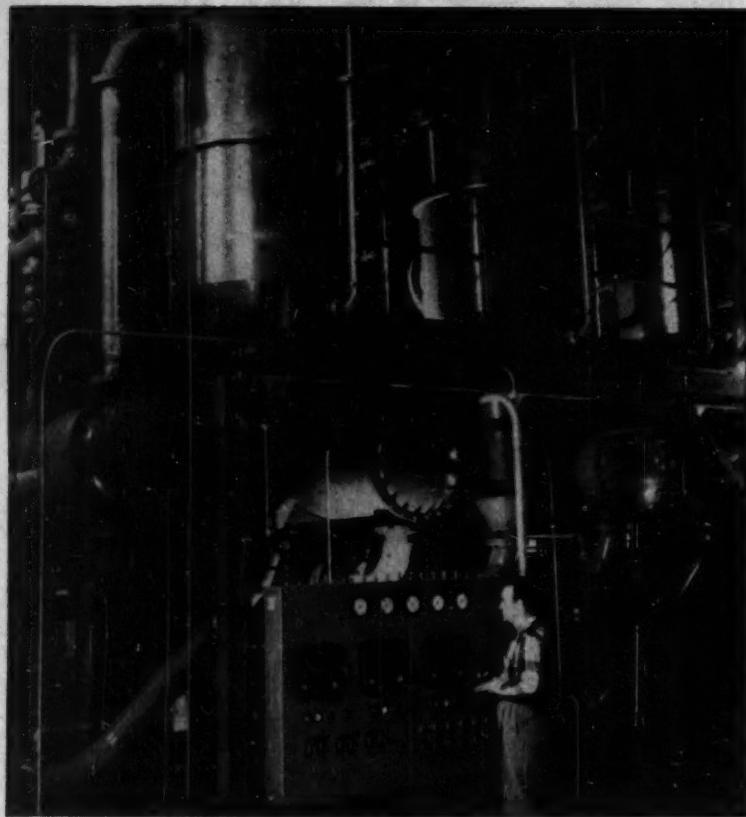
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TRIPLE-EFFECT evaporator helps recover useful products from lignin.

## From Pollution to Profit

**Major engineering changes will soon boost Marathon's lignin derivatives capacity by 15 million lb. per year. Products find many uses, chiefly as dispersants.**

A new precedent is being set in the pulp and paper industry. Marathon Corp.'s chemical division is processing and marketing not only all the

lignin effluent from the parent company's mill; it's also buying additional concentrated effluent from another company's nearby mill.

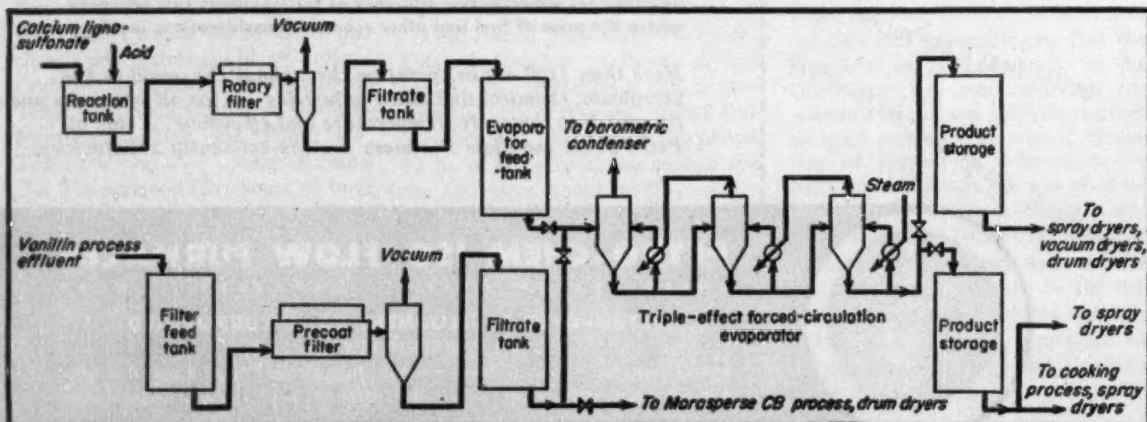
This unique situation is the result of an expansion and modernization program at Marathon's Rothschild, Wis., mill. In the past two years \$500,000 worth of equipment has been installed. Major new items are a forced-circulation triple-effect evaporator, a stainless-steel rotary vacuum filter, a precoat filter, a spray dryer and 13 storage tanks. Marathon's lignosulfonate derivatives capacity will now be 39 million lb. of powders and 36 million lb. (solid basis) of liquid products.

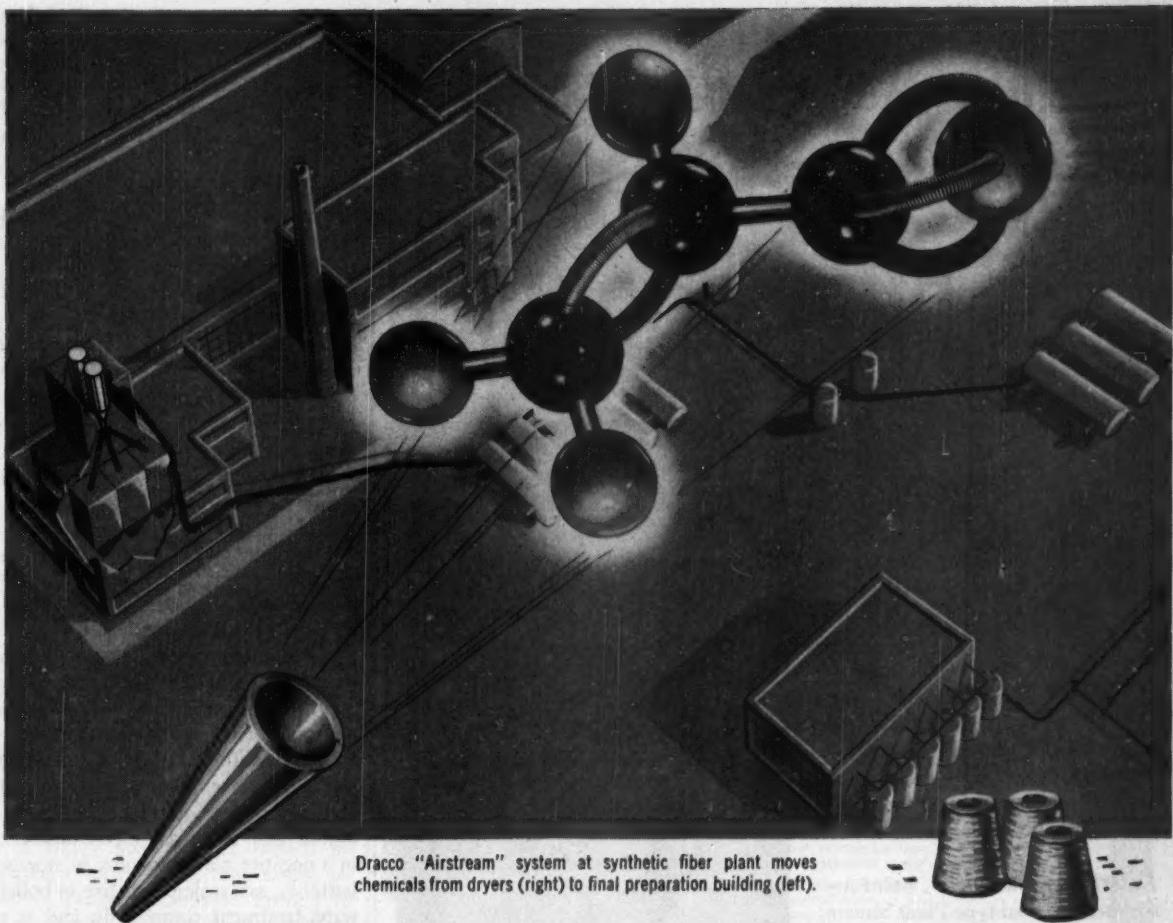
Working up to this expansion wasn't easy. An uphill drag since the first commercial lignin derivatives were produced in 1937, the development of sound markets has cost Marathon \$2 million in research and another \$1.75 million in plant. The chemical division was in the red until 1945. In 1951 and 1952, however, all production was sold, and a 50-percent increase in sales is predicted by 1954.

► Many Derivatives—Lignin recovered as basic calcium lignosulfonate can be converted to a number of derivatives, each with different properties. Calcium can be replaced by Na, Mg, NH<sub>4</sub>, etc. Other parts of the molecule can be altered by varying the degree of desulfonation, demethylation or oxidation by proper control of temperature, pressure and pH.

With each alteration of the basic materials comes new uses. An intensive market development program has established a number of basic applications and points the way to new potential markets that may soon be important.

Vanillin was the first derivative ever sold and is still an important market. Salvo Chemical Co. makes over 50





Dracco "Airstream" system at synthetic fiber plant moves chemicals from dryers (right) to final preparation building (left).

## JET-PROPELLED CHEMICALS FOR MIRACLE FIBERS

**Handling Problem**—To move powdered intermediate chemicals some 600 feet from primary processing to final processing at a large synthetic fiber plant. System must be simple, fast and economical—and must handle materials without loss or contamination.

**Dracco Solution**—Application engineering by Dracco proved that the best solution for this materials handling problem was a custom-engineered, automatic Dracco "Airstream" Conveyor. This system (in diagram form) is shown above.

**Result**—The Dracco "Airstream" Conveyor provides simplified, accurate handling which eliminates expensive manual methods. Self-cleaning, it guards the required high purity of chemicals for producing modern "miracle" fibers.

Materials from primary process dryers are now weighed, fed into the "Airstream" system—then jet-propelled directly to final preparation tanks. Transported at five tons per hour through the enclosed, dust-free system, there is no chance for waste or contamination.

Dracco engineers will be glad to explain how the cost-cutting "Airstream" technique can simplify your bulk materials handling problem. Write or call today.

**DRACCO CORPORATION**  
4044 East 116th Street • Cleveland 5, Ohio



"Bulk Materials Handling with 'Air-stream' Conveyors" is the title of Dracco Bul. 529. Request your copy now.



**DRACCO**  
*Airstream* CONVEYORS • DUST CONTROL EQUIPMENT

*Performance Proved*

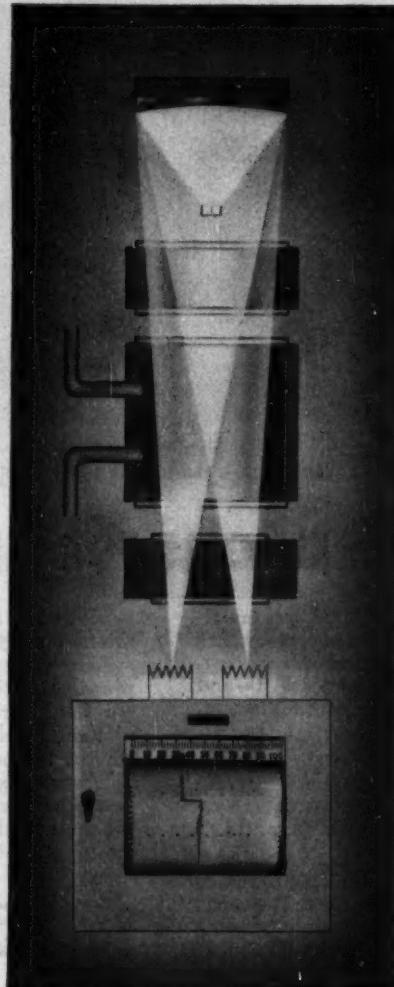
# When you're talking $\text{CH}_2=\text{CH}_2-$ IS 99% PURE PURE ENOUGH?

**Problem . . .** To secure the highest possible purity in ethylene production, with minimum contamination by ethane and methane, under continuous production conditions.

**Approach . . .** Continuous analysis of the product stream, by means of differential infrared absorption, to replace slower batch methods of analysis involving orsat techniques or mass spectrometry.

**Instrumentation . . .** Baird Associates infrared-type Plant Stream Analyzer, for simplicity, speed, sensitivity, proved reliability under plant conditions, and continuous automatic indication.

**Results . . .** The Plant Stream Analyzer in this application is calibrated to indicate 95% ethylene purity at scale zero, and 100% at full scale. Concentration can be read to an accuracy of 0.1%. Small variations in concentration are revealed almost instantly, allowing process readjustment in ample time to prevent any significant loss in product quality.



## PROCESS CONTROLS

A division of Baird Associates, Inc.

11 UNIVERSITY ROAD CAMBRIDGE 38, MASSACHUSETTS

### WHAT'S HAPPENING, cont. . .

percent of the vanillin consumed in the U. S., using Marathon liquor and a process developed in cooperation with Marathon.

► **Surface Activity**—Dispersant properties account for the bulk of present sales and will undoubtedly continue to do so. A calcium lignosulfonate (Marasperse CK) controls fluidity of oil-well drilling muds by the "lime-breakover" procedure. Contaminants (gypsum, anhydrite, salt, etc.) which tend to flocculate sodium-based muds have no effect on lime-based muds using this dispersant. Another derivative (Marasperse CE) stabilizes drilling mud emulsions in the presence of saturated brines.

Marathon currently supplies a significant portion of the approximately 60-million-lb. demand for organic dispersants in drilling muds and can see the possibility of an increase in its share of this market.

Other already commercialized uses for some of the lignosulfonate derivatives are: With carbon black in making synthetic rubber tires; as a dispersant for pigment dyes; in insecticide formulations and industrial metal cleaners; in a negative plate expander in storage batteries; as a scale preventive in boiler water-treatment compounds; and as a tanning agent in the leather industry, replacing a portion of the vegetable tans ordinarily used.

The future holds promise of a number of new applications: Stabilizing wax and asphalt emulsions; in electroplating baths and phosphatizing compounds; dispersing paper mill pitch to reduce paper machine downtime; in grinding portland cement clinker; in gypsum board manufacture; in ore beneficiation flotation circuits; in adhesives, wallpaper and ceramic ware.

► **How They're Made**—Spent sulfite liquor (its organic content represents 50 percent by weight of all wood pulped—75 million lb. per year in Marathon's case) is treated with lime to precipitate inorganics (mostly calcium sulfite), which are returned to cooking acid system. More lime is added to the overflow liquor to precipitate basic calcium lignosulfonate—the raw material for the derivatives plant.

Some of this material is spray-dried without further processing, but most of it goes to various reaction tanks, where it is dissolved by sulfuric acid. A sulfate of some metal may be

added, depending on the end product desired. The new continuous rotary vacuum filter (which replaced a plate-and-frame filter press) removes calcium sulfate and yields a filtrate containing the lignosulfonate derivative, ready for evaporation.

The new triple-effect forced-circulation unit has replaced a number of smaller single-effect evaporators. Evaporator product goes to storage tanks and, depending on product involved, may feed vacuum dryers, atmospheric double-drum dryers or the spray dryers.

The new spray dryer is a semi-outdoor installation (uncommon this far north) and is the largest ever built by Western Precipitation Corp. The tangentially fired vertical furnace has a variable-speed atomizer with a 6,000-12,000 rpm. drive range and a wet cyclone secondary dust collection system.

Some of the basic calcium lignosulfonate is treated with caustic soda, oxidized and partially desulfonated by a controlled cooking process. Vanillin thus formed by splitting some of the lignin molecules is isolated by Salvo. The remaining organics are returned to Marathon for further processing.

A rotary precoat filter (which replaced a battery of settling tanks) removes calcium carbonate formed in the vanillin process. Filtrate is fed to the triple-effect evaporator. Evaporator product is stored for diversion to a number of processes. Some is spray-dried and sold. Another portion is cooked in contact with air or stack gases and converted to other derivatives, which can be spray dried and sold for use in boiler water treatment.

A large portion of this material is purified by precipitating in sulfuric acid solution, filtering, redissolving in caustic, evaporating again and then feeding to the drum dryers.

### New AEC Plant in Illinois Will Process Explosives

A new explosives processing and assembly plant will be built 18 mi. east of Macomb, Ill., on the Spoon River for the U. S. Atomic Energy Commission. The new plant will not manufacture radioactive material.

About 9,800 acres of government-owned land, formerly the site of Camp Ellis during World War II, have been turned over to AEC by the General Services Administration. Only about

**DO IT WITH EASE\***

## \*Electronic Analog Simulating Equipment by Berkeley

Lowest  
Priced  
Computer  
in the  
Quality Field!



Typical Low Priced EASE COMPUTER Installation showing 20-channel operational amplifier and power supply, 2-channel function generator, 3-channel function multiplier, typical variable component and over-voltage panel, 30-channel problem board.

#### Features These Components:

Ten Channel Operational Amplifier and Power Supply performs summation, sign reversal, multiplication by a constant, or integration.

Two Channel Function Generator transforms input voltage functions into arbitrary output voltage functions by fitting twenty-two line segments to the curve desired.

Function Multiplier extends operation to multiplication of two dependent variables, solution of non-linear equations and linear equations with variable coefficients—for example, two dependent variables.

Removable problem boards plug into receptacle housing which includes problem components available in standard or custom arrangements.

Basic 10-channel amplifier and power supply unit, the heart of any analog computer, can be purchased for little more than \$1,000. Additional 10-channel units and other special components offered at correspondingly low prices.

The New EASE Computer, now manufactured by Berkeley Scientific is specifically designed to meet the growing demand for an Analog Computer which is low in cost and yet flexible enough to be successfully utilized by design engineers in every industrial, military, research and educational group working on problems of dynamics.

EASE Computers are already effecting tremendous savings of time and money in a number of varied applications. A leading manufacturer of jet aircraft is using the EASE Computer as a flight simulator to prove design still on the drawing board. Several engineering and research organizations have found the computer indispensable in the study of guided missiles. And the Automatic Factory of Tomorrow may soon become a reality as universities throughout the country study the problem of "fully automatic control" with the aid of such computers.

By far the lowest priced quality instrument in the field, the EASE Computer is the ideal equipment for use as an equation solver, simulator or tester. The unitized design employing compact rack-mounted components permits the user to select a custom computer which meets his particular requirements.

For complete data, please request Bulletin B4

Berkeley Scientific

division of BECKMAN INSTRUMENTS INC.  
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

M-8

## WHAT'S HAPPENING, cont. . .

900 acres of the land for the AEC plant will be taken from the 6,400-acre area that CSA will release to private purchasers.

The new AEC plant, to be called the Spoon River plant, will cost about \$29 million. Construction will begin early this spring.

Fluor Corp., Ltd., of Los Angeles is architect-engineer for the project. Most of the construction work will be on a lump sum basis, with competitive bidding. Approximately 2,000 construction workers will be required late this year.

The plant will be operated by a private contractor not yet selected. Employment of operating personnel will not exceed 2,000. Hiring will not begin until construction is nearly complete, probably in mid-1954.

## RFC Reopens GR-S Copolymer Line at Institute Plant

Another copolymer line at RFC's synthetic rubber plant at Institute, W. Va., is being reactivated to meet increased requirements of the nation's rubber industry.

Reopening of the Institute unit will make possible production of an added 3,500 long tons of regular GR-S each month.

Meantime, two recently reactivated units at the Kobuta, Pa., plant of RFC are producing butadiene from alcohol. Two others at Louisville, Ky., are also resuming production of butadiene.

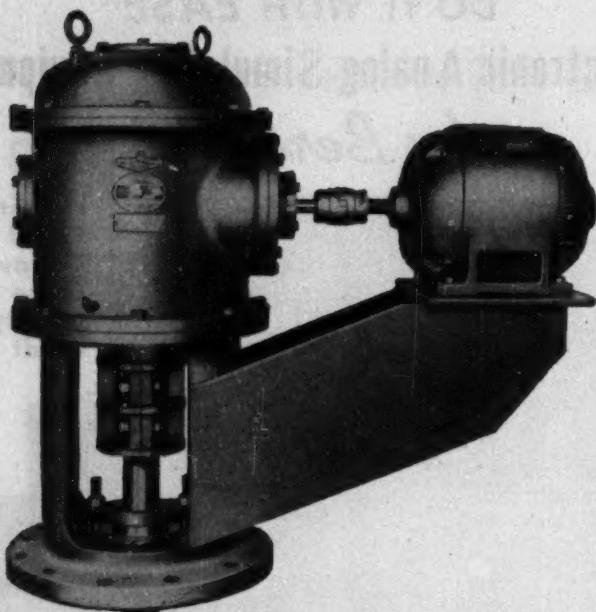
The Institute plant is operated for the RFC by B. F. Goodrich Chemical Co.

## Monsanto Now Turning Out Acrylonitrile at Texas City

Acrylonitrile is now being shipped from the new Texas City plant of Monsanto Chemical Co. The first tank car of acrylonitrile went to the Chemstrand Corp. at Decatur, Ala.

The Texas City plant produces acrylonitrile from acetylene. Monsanto gets its acetylene from natural gas. In the conventional process, acetylene is made from calcium carbide.

"This new source of supply of acrylonitrile," says R. U. Haslanger, general sales manager of Monsanto's Texas Division, "will be good news to the chemical industry. The growth of the synthetic fiber industry will be



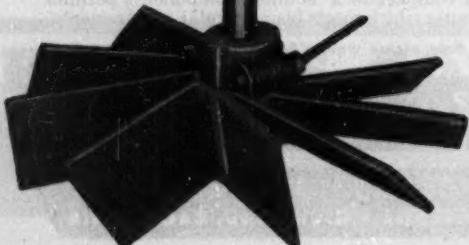
# Best in the long run

Agitation is like other process operations. Initial cost of agitating equipment is usually small when compared with the power and the time consumed by the actual processing operation itself. That's why it pays to get the best in agitating equipment.

Each Nettco Agitator is an engineered combination of standardized components — motors, drives, shafts, stirrers. Each Nettco Agitator gives you the most for your money in the long run...by saving power, time, and upkeep. For full details, data, and recommendations, write New England Tank & Tower Company, 877 Tileston Street, Everett 49, Mass.

# NETTCO

Foremost in ENGINEERED AGITATION for over half a century



greatly helped by this new large productive capacity."

Acrylonitrile is an important raw material in the manufacture of the new acrylic fibers such as Chemstrand's Acrilan. Monsanto's production will be divided between Acrilan and other uses.

In addition to its use in synthetic fibers, acrylonitrile is also used in the manufacture of antioxidants, dyes, emulsifying agents, plasticizers, insecticides, fumigants, and photographic emulsions. Combined with butadiene, acrylonitrile is used to produce Buna-N, a synthetic rubber.

Copolymers are also used in the manufacture of resins and emulsions for the paper, leather and textile industries.

#### CONVENTION CALENDAR

Commercial Chemical Development Association, annual meeting, Statler Hotel, New York, March 23-24.

Third Midwestern Conference on Fluid Mechanics, University of Minnesota, Minneapolis, March 23-25.

American Pharmaceutical Manufacturers Association, annual meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., March 30-April 1.

Electrochemical Society, spring meeting, Statler Hotel, New York, April 12-16.

American Drug Manufacturers Association, annual meeting, Boca Raton Club, Boca Raton, Fla., April 13-16.

Association of Consulting Chemists & Chemical Engineers, symposium, Belmont Plaza Hotel, New York, April 21.

American Institute of Chemical Engineers, joint meeting with Chemical Institute of Canada, Royal York Hotel, Toronto, April 26-29.

First Iowa Thermodynamics Symposium, heat and mass transfer, State University of Iowa, Iowa City, April 27-28.

American Oil Chemists' Association, annual meeting, Roosevelt Hotel, New Orleans, May 4-6.

Society of the Plastics Industry, annual meeting and conference, cruise to Bermuda, May 9-15.

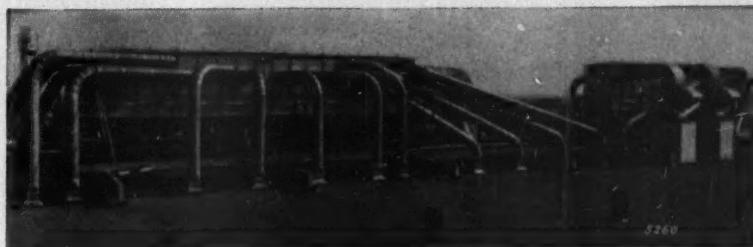
American Institute of Chemists, annual meeting, Philadelphia, May 12-13.

Chemical Specialties Manufacturers Association, midyear meeting, Drake Hotel, Chicago, May 17-19.

Armed Forces Chemical Association, annual meeting, Waldorf-Astoria Hotel, New York, May 20-21.

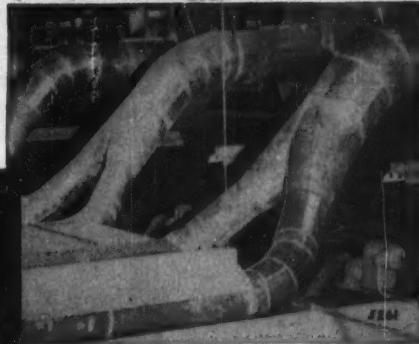
# SLY

## PIONEERS and LEADERS in INDUSTRIAL DUST CONTROL



Philip Morris plant at Louisville, Ky. with Sly Dust Filters on roof.

Ducts leading from tobacco separators to Sly Dust Filters handling a total of 96,000 cfm.



### PHILIP MORRIS IS GLAD THIS YEAR THEY INSTALLED **SLY** YESTERYEAR



• Something wonderful happened in the construction of this modern Philip Morris plant. It was designed and equipped for *dust-free* operation.

Tobacco dust, created in stemming operations, is drawn through ducts to the four large Sly Dust Filters on the roof, and thoroughly filtered.

The clean air is then returned to the plant and recirculated — saving substantially on winter heating costs.

Philip Morris knows the value of Sly Dust Filters by experience, having purchased these units throughout the past five years.

Because of their larger filtering capacity and easy replacement of bags, Sly Dust Filters offer definite advantages in economy of operation and lower maintenance.

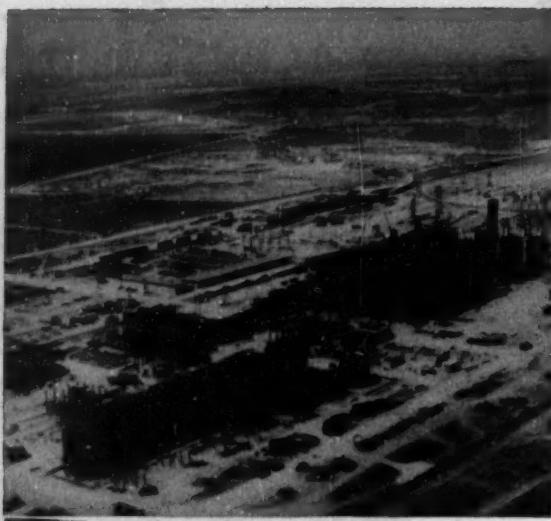
If you will tell us your dust problem we shall be glad to tell you what can be done about it and give you an estimate of cost.

THE W. W.

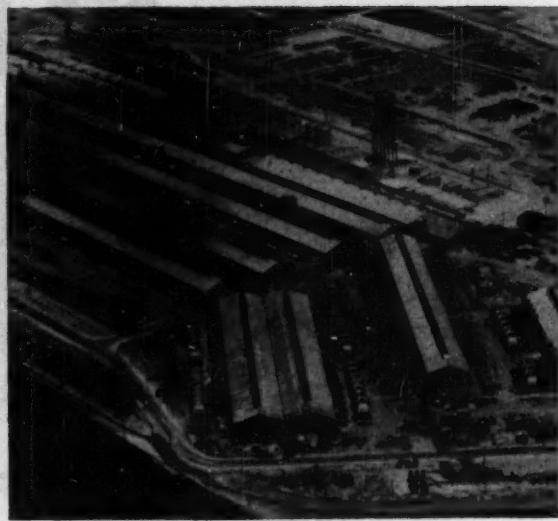


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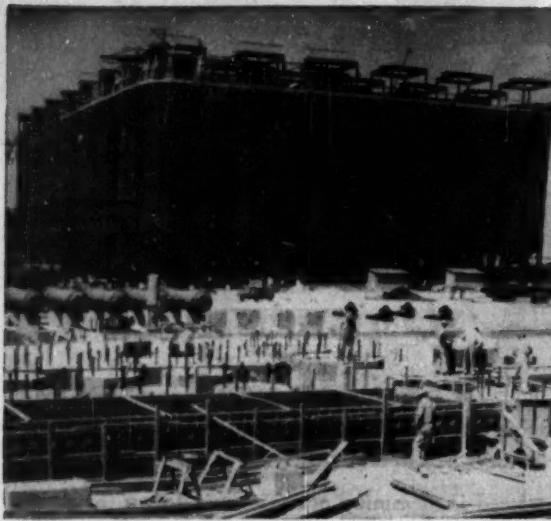
4771 TRAIN AVENUE • CLEVELAND 2, OHIO  
New York • Chicago • Philadelphia • Syracuse • Detroit • Buffalo  
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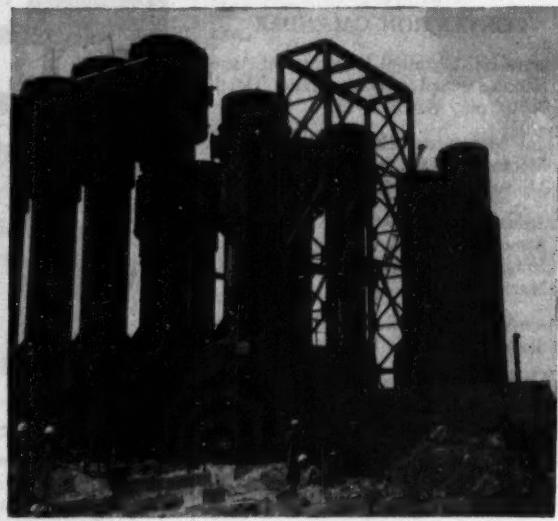
ALUMINA plant now under construction will soon supply . . .



ALUMINUM plant, already making 80 million lb. per year.



OUTDOOR theme for alumina precipitators is repeated in . . .



EVAPORATOR system of integral, self-supporting units.

## Giant Pots Feature Integrated Al Plant

**Cells are said to be the largest in the industry. Reynolds is adding new facilities for bauxite processing to its recently completed reduction plant.**

A few miles to the east of Corpus Christi, Tex., Reynolds Metals Co. is completing the only aluminum plant in the United States where bauxite ore will be brought in by deep water transportation from the mines and processed to pig metal.

Standout feature of the reduction plant is the size of the electrolytic cells, or pots. According to a Reynolds-prepared newspaper story ap-

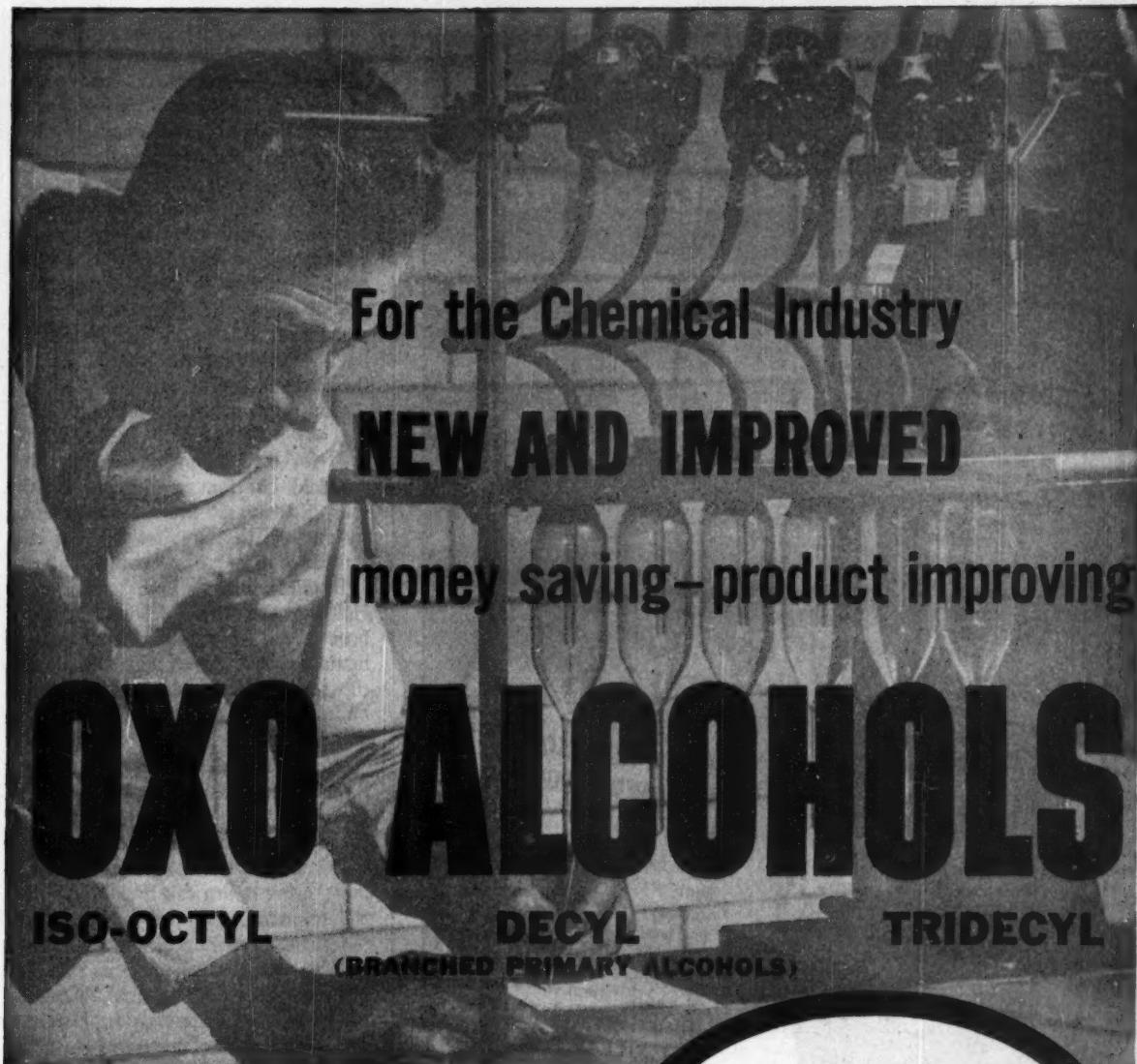
pearing in the Corpus Christi Times, the pots are designed for 105,000 amperes, which is two to three times conventional currents; however, the actual current at which they are operating hasn't been disclosed.\* This

\*Reynolds issued reports recently on the enlarging of the cells at its Longview, Wash., aluminum plant by cutting each individual cell in two and welding in another center section. This permitted raising the current through these pots from 32,000 to 54,000 amperes.

much is evident: Reynolds rates each of its two potlines at 80 million lb. per yr.; latest plants of both Alcoa and Kaiser rate their potlines at 42 to 50 million each. It's extremely doubtful that much of this difference, if any, comes from longer lines with higher over-all voltages.

Among the changes in the alumina plant is the use of caustic soda for leaching the bauxite, instead of the more generally used lime and soda ash. It will be obtained from a nearby producer.

► **Outdoor Construction—Designers of the \$42-million alumina plant, known**



For the Chemical Industry

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**ISO-OCTYL**

**DECYL**

**TRIDECYL**

(BRANCHED PRIMARY ALCOHOLS)

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### **SURFACE COATING**

PETROHOL 91  
PETROHOL 95  
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Secondary Butyl Alcohol  
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Isopropyl Acetate  
Acetone  
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Ethyl Ether  
Isopropyl Ether  
Dicyclopentadiene  
Naphthalic Acids  
Iso-Octyl Alcohol  
Decyl Alcohol

### **CHEMICAL**

PETROHOL 91  
PETROHOL 95  
PETROHOL 99  
Iso-Octyl Alcohol  
Decyl Alcohol  
Tridecyl Alcohol  
Dicyclopentadiene  
Isoprene  
Butadiene  
Ethyl Ether  
Isopropyl Ether  
Tripropylene  
Tetrapropylene  
Aromatic Tars  
Acetone  
Methyl Ethyl Ketone

The Enjay Company has long been recognized as a leader in the development and marketing of high-quality products for the oil, surface coating and chemical industries. Backed by greatly expanded plant and distribution facilities, the Enjay Company is supplying a constantly growing list of chemical products to many different industries.

**BE SURE TO CALL ON ENJAY FOR YOUR CHEMICAL NEEDS**

**ENJAY COMPANY, INC.**

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*Specifically Designed*  
for WATER PRESSURE CONTROL

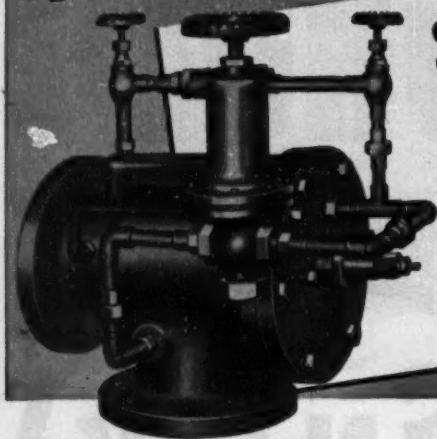
GOLDEN-ANDERSON CUSHIONED  
WATER PRESSURE REDUCING VALVE

Used to protect water lines where high initial pressures would cause serious damage to distribution mains, this very sensitive valve will maintain a uniform delivery pressure. Bulletin W-3 will interest you.



GOLDEN-ANDERSON  
CUSHIONED SURGE  
RELIEF VALVE

This valve is used to protect water lines against excessive pressures caused by surges in the system, and will open immediately when inlet pressure exceeds the adjustment of the pilot. Bulletin W-2 sent on request.



For over 50 years, Golden-Anderson has specialized in designing and manufacturing pressure control valves. The patented air and water cushioning feature effectively prevents any bang or hammer.

May our experienced engineers help you with your water pressure control problem?

IMMEDIATE SHIPMENT  
FROM STOCK ON  
MANY SIZES.

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*Valve Specialty Company*

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WHAT'S HAPPENING, cont. . .

as the La Quinta plant, have gone further than designers of similar plants in putting process equipment outdoors. Precipitators, digesters, flash tanks and evaporators will be exposed to the weather. To do away with the building completely, self-supporting evaporators are being installed. These evaporators, new to the aluminum industry, are of the integral type with six effects. Boilers will be outdoors, but the turbogenerators will be inside the power house.

Construction on this plant got under way early last year; the schedule calls for completion this spring. It was laid out for an ultimate 2,000 tons capacity; at present equipment for one-half that amount is being installed.

Bauxite will come from Jamaica and Haiti. As the ore is unloaded from the boat it will be carried over an automatic sampling device and then along the top of the storage and blending building, where it can be unloaded at any point.

► Ore Processing—The customary Bayer process will be used to process the ore to alumina. In the first step the ore (aluminum hydrate and impurities) will be wet-ground in rod mills, using return caustic liquor from the evaporators.

Caustic soda concentrations intermediate between American and European practices will be used, because of the nature of the bauxite. Haitian ore is a mixture of monohydrate and trihydrate and appears to be intermediate in solubility between ore found in the Americas and that found in Europe. Jamaican bauxite contains less monohydrate and more trihydrate than Haitian material; there are some ores in Jamaica that are almost entirely trihydrate.

The mixture of ground ore and caustic will be further fortified in a slurry tank and then pumped into a vertical digester. Here it will be treated with live steam and stirred, yielding sodium aluminate, water and undissolved impurities. The latter will be removed by settling and filtering.

Cool, clarified strong aluminate liquor will be treated in a battery of precipitation tanks. To this liquor will be added fine aluminum hydrate from the seed tanks and the contents agitated for 24 to 30 hours, during which time the alumina will be precipitated. The aluminum hydrate pre-

cipitate will be removed, washed, filtered and sent to dehydrating kilns. The resulting alumina will be conveyed to a 6,000-ton silo for storage.

Since the output of the alumina plant will be more than enough to meet the requirements of the adjacent reduction plant, some of it will be shipped to the company's reduction plants at other locations.

► **Reduction Plant**—Reynold's San Patricio reduction plant, adjacent to the La Quinta alumina plant, began production in April 1952; the second of the plant's potlines made its first metal early last October. The plant was built at a cost of \$80 million and has a capacity of 160 million lb. of aluminum annually.

Regardless of their exact size, Reynolds unquestionably has at San Patricio the largest potlines in the aluminum industry. The size of the pot has much to do with the power efficiency of the reduction operation (the number of kwh. per lb. of metal). Since approximately 10 kwh. per lb. is consumed, power is an important item of cost. The large pots waste less heat and apparently make possible important economies in the number of kwh. required to produce each pound of metal.

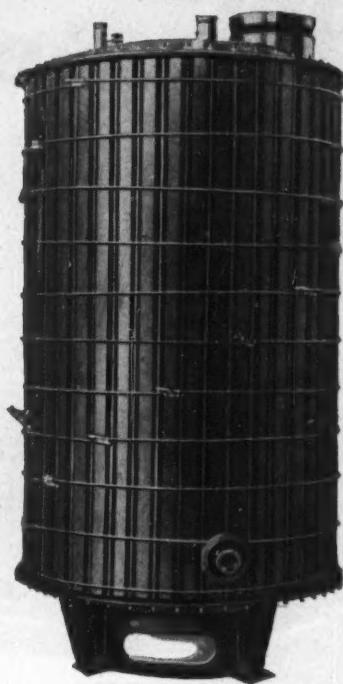
Furthermore, Reynolds has found that the larger pot makes for more uniform operation. The larger working area of the Soderberg anodes used in the San Patricio reduction plant (four times as large as the ones at the company's Listerhill, Ala., plant) assures much steadier operation at the point of maximum efficiency. This, in turn, contributes to higher over-all average efficiency.

► **Power Distribution**—To obtain the least possible length of bus bars with the lowest possible power loss the four pot rooms, each 1,580 ft. long, are arranged alongside each other with the power plants at one end. Bus bars connect the generators to the first pots in each line. Power is conducted from pot to pot in one building until it reaches the far end. Other bus bars then connect to the next building, where the current is conducted from pot to pot back until it reaches the end of the second building near the generator plant and has made a complete circuit. In this way two rooms are used to make a single potline and total bus bar requirements are kept at a minimum.

When a cell is in operation the molten aluminum, as it is produced,

## FOR BIG, CORROSION-RESISTANT TANKS

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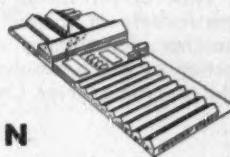
Get what you want with a Haveg-engineered tank. Haveg is not a lining or coating. It is a solid, non-metallic material (resistant to corrosion through and through) that is molded by the Haveg Corporation into tanks as large as 10 feet in diameter by 12 feet in depth. These are single piece, without seams or joints. By joining such sections, even larger tanks can be built. Low cost, with exceptionally long life.

From top to bottom, a Haveg tank has special design features to improve handling acids, bases, salts in your plant. Flat, sloping, cone, dished bottoms are molded to fit your drainage needs. Because Haveg can be machined and repaired on the spot, any change in piping is easily made by your own plant crew.

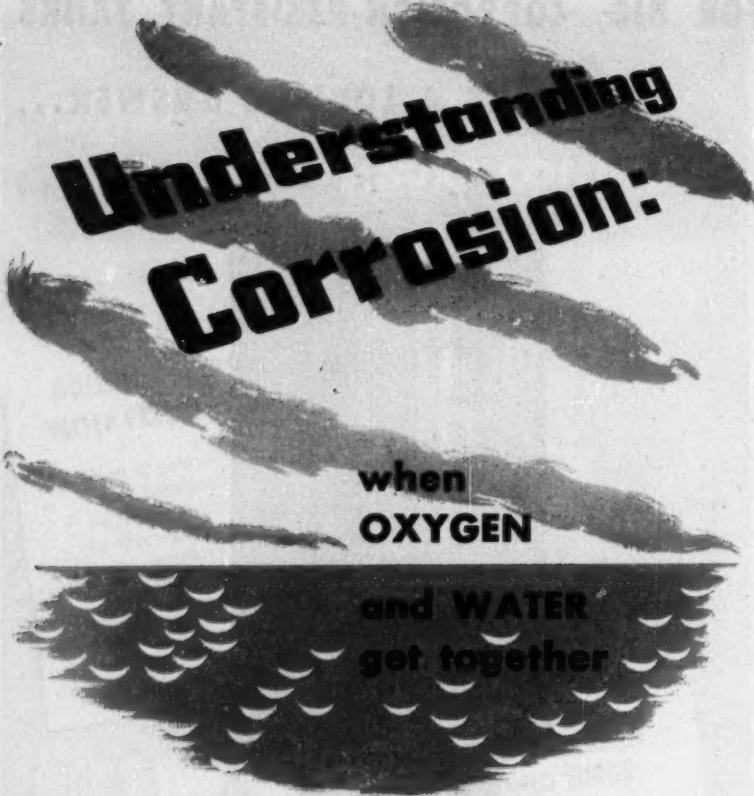
Work with a company that understands how to fight corrosion. Haveg has thousands of molds for any type of chemical handling equipment. Get the complete Haveg story by contacting your Haveg sales engineer and writing for a 64-page technical bulletin (F-6). It shows tank sizes, installation and machining tips, complete chemical resistance tables. Write now . . . for Haveg is a logical answer, both material and engineering-wise, for corrosion-resistant tanks, towers, pipes, valves, fittings.

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**W**hen free oxygen combines with atmospheric moisture or natural waters, the stage is well set for corrosive action. Controlling the degree and extent of that action are many related factors, variable in influence under differing circumstances.

The rate at which oxygen is transferred from atmosphere to a solution is, for example, directly proportional to the amount of exposed surface area of that solution, while the corrosion rate of immersed metal is, in turn, proportional to the oxygen concentration of the solution. Therefore, with all other factors stabilized, a reduction in exposed surface area will slow the oxygen-solution process, thereby greatly retarding corrosion.

How deeply metal is immersed, particularly in a quiet solution, is another determinant of corrosive action in which dissolved oxygen is the governing factor. Oxygen satura-

tion, highest at and near the surface, diminishes with increasing depth as convection currents become less active. Corrosion at and immediately below the surface of a liquid is therefore far more severe than that encountered at greater depths.

These and other variables that combine to produce a given corrosion problem must be evaluated in any attempt to reach an effective and practical solution. Such evaluation, based on thirty-five years' corrosion-control experience, is standard Dampney procedure. That is why your specification of a Dampney Coating assures you so much *more* — protection you can depend upon to meet not only standard industrial service requirements but your specific equipment-operating needs. For data on Dampney Protective Coatings and their place in your corrosion-control program, write

#### WHAT'S HAPPENING, cont. . .

is permitted to accumulate until there is a 5-in. layer on the bottom of the pot. At this point one inch is removed by siphoning into a vacuum crucible. This is a large sealed vessel with a heavy cast-iron pipe connected to the top and shaped so it will reach down into the layer of metal in the bottom of the pot.

►Cranes and Trains—The vacuum crucibles, with their 6,000-lb. loads of molten metal, are handled from the pots to the center passage of the pot-rooms by overhead electric cranes. There are two 30-ton cranes in each pot room; each carries two 15-ton hoists.

By means of the cranes crucibles can be deposited on small flat cars which travel over a narrow-gage railway into the metal service building, where another crane takes over. Here the metal can be cast immediately or sent to one of the holding furnaces. These include two 60,000-lb. capacity units and one that holds 120,000 lb.

Aluminum can be cast into any one of three direct-chill casting machines, into one of four pouring wheels making 50-lb. pigs, or into stationary pig molds making up to 1,000-lb. pigs. Equipment is available to make special ingots weighing from 1 to 10,000 lb. each.

The metal can be fluxed, skimmed and dressed in the holding furnaces. Also it can be alloyed with various elements as desired. The ingots are shipped to the company's rolling mills at Listerhill, Ala., and McCook, Ill.

#### Polythene Derivative Imparts Ozone Resistance to Rubber

Longer lasting and improved rubber products are the prospect held out by a team of Du Pont chemists. They have developed a chlorosulfonated polythene, which when blended with natural and synthetic rubbers prevents cracking due to ozone attack. Du Pont is now producing semi-commercial quantities of the chlorosulfonated polythene at Belle, W. Va.

The chemists were Robert T. Currin, Ward J. Remington, William B. Clark, John J. Ondrejcin and George H. Bowers, all members of a research team at Du Pont's Wilmington laboratories. They point out that cracks in tires and other rubber products exposed to the weather result from the attack of ozone, present in the atmos-

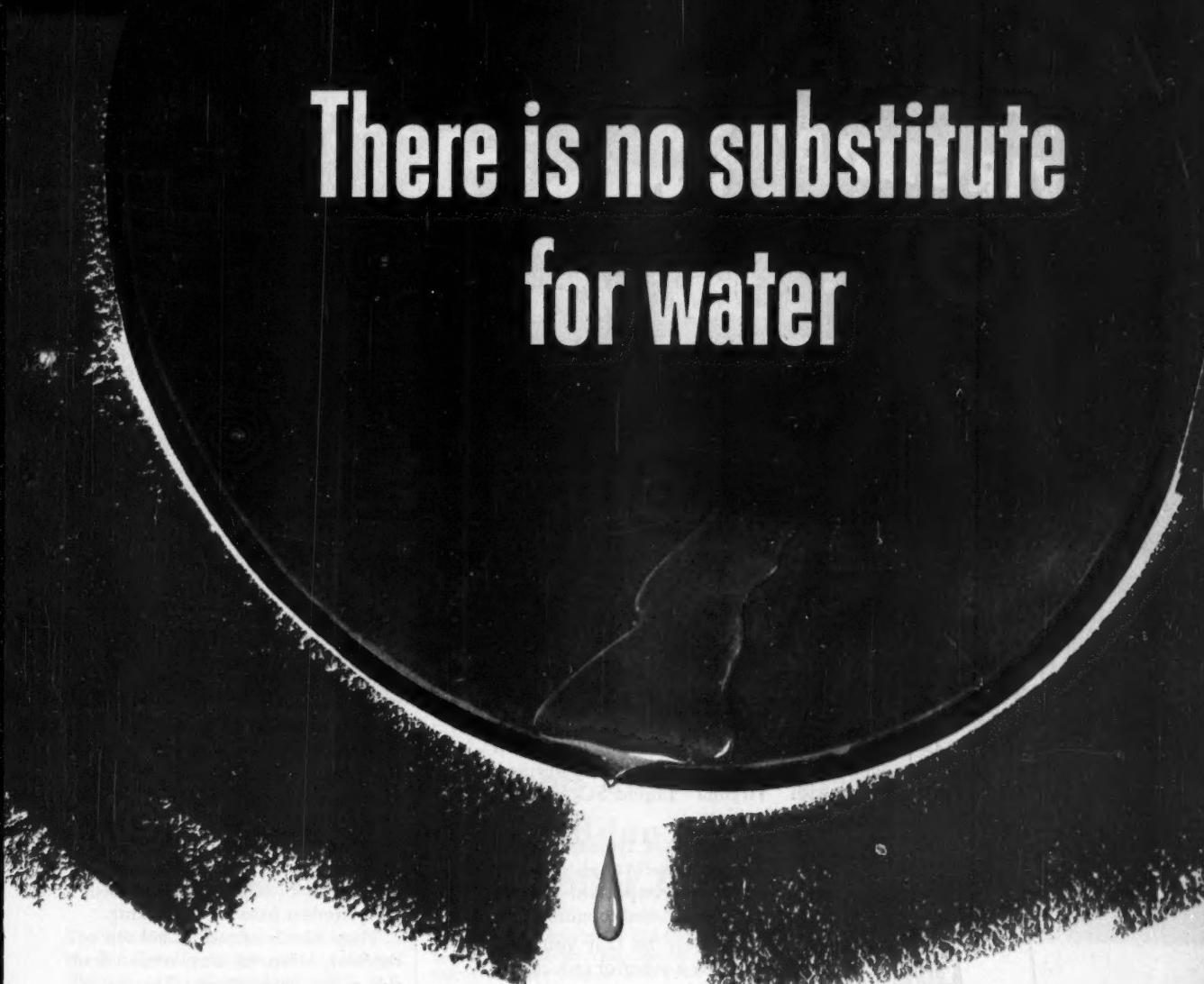
MAINTENANCE  
FOR METAL

THE  
**DAMPNEY**  
COMPANY

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150-1

# There is no substitute for water



**...and there is no substitute for experienced engineering  
in developing a dependable water system**

Nothing has ever taken the place of water among the basic needs of man. And nothing will ever take the place of safe, sure, *experienced* engineering in developing a dependable water supply.

Layne's reputation as the world's most experienced developer of well water systems was earned by engineering skill every step of the way—from on-the-spot geological surveys to the precision designing of each pump

for its particular job. For the best in well water systems, there is no substitute for Layne engineering.

**Let Layne engineers help you  
PLAN AHEAD on your water needs**

Layne welcomes the opportunity to share in long-range planning for water-system needs. Contact your nearest Layne Associate Company or write Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.



**WATER WELLS**

**VERTICAL TURBINE PUMPS**

*Layne Associate Companies Throughout the World*



## Better fuel for jets and diesels

Modern jet and Diesel engines need fuel with a high cetane rating. It's just as hard to produce this high cetane fuel as it is to make high octane gas for conventional engines. The method employed is the Edeleanu Process. "Virginia" Liquid Sulfur Dioxide ( $\text{SO}_2$ ) is widely used in most of the Edeleanu units in the country's big refineries.

High cetane fuel is somewhat similar to kerosene. To make it satisfactory for jet engines, however, it must be highly purified. Extraction under pressure with "Virginia" Liquid  $\text{SO}_2$  removes the impurities from the kerosene fraction.

Here is a typical example of a successful application for  $\text{SO}_2$  in an important segment of the national economy.

It may be that you have use for a superior reducing or bleaching agent, preservative, antichlor, neutralizer or pH control. We'd like to help you to greater efficiency and profit by adapting our versatile  $\text{SO}_2$  to your products or processes. We would welcome a request on your business letterhead for the descriptive "Virginia"  $\text{SO}_2$  booklet.

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### WHAT'S HAPPENING, cont. . .

phere in amounts less than 10 parts per 100 million.

Exposed in the laboratory to air containing more than 1,350 times this amount of ozone, the new chlorosulfonated polythene did not show a single crack. In fact, it has never been found to fail in ozone.

By blending the new elastomer with certain rubbers, the Du Pont researchers have been able to improve markedly the ozone resistance of the rubbers.

A synthetic rubber widely used in tires was blended with 25 percent of the Du Pont elastomer and put under strain comparable with that in a tire sidewall. It showed no sign of cracking even after exposure for 4 months to an ozone concentration found only in a few sections of the United States. Under corresponding conditions, the same rubber, without the chlorosulfonated polythene in it, showed ozone cracks within 24 hr., as did natural rubber.

Even when the 75-25 blend of this synthetic rubber for tires and the new Du Pont material was exposed to an ozone concentration about 400 times greater than that ever found outdoors, there was no failure.

The researchers report that sidewalls of test tires thus far have shown complete freedom from ozone cracking.

These blends can withstand service outdoors. Moreover, many remain flexible at low temperatures. This points to their use as stripping for doors and windows of airplanes and autos, where cracking has long been a problem. Other likely uses: rubber parts for farm machinery, conveyor belts, wire covering, engine mountings, unsupported hose and mechanical rubber products.

### RFC Purchases Alcohol For Butadiene Plants

Reconstruction Finance Corporation has purchased about 15 million gallons of alcohol from three suppliers for use in producing butadiene at two government synthetic rubber plants.

The suppliers are the Eastman Chemical Products, Inc., Kingsport, Tenn.; the Enjay Co., New York City, and Publicker Industries, Inc., Philadelphia, Pa. Each will furnish about 5 million gallons.

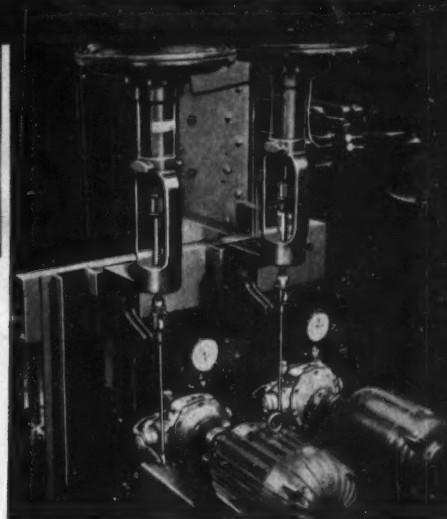
The alcohol will be delivered f.o.b. barge or tank cars at the RFC's Louisville or Kobuta plants. Deliveries will

# "ONE OF THE Highest Efficiency Units" IN THE UNITED STATES



OILGEAR

View in J. I. Case Co. tractor works at Racine, Wis. Boiler front and Detroit Roto-Grate Stoker on 100,000 lb. per hr. boiler unit.



## And Oilgear's Range and Control help capture savings hidden in J. I. Case 100,000 lb. Boiler Unit

The 100,000 lb. per hour boiler unit in the J. I. Case Co. tractor works at Racine, Wisconsin, has demonstrated that it is one of the highest efficiency units in the United States. To obtain such high efficiency, careful tests of variable speed drives for fuel feed and grate travel were made during two years. Finally, Case engineers selected Oilgear Fluid Power Drives, for, as Mr. Cole H. Morrow, Chief Plant Engineer says, the Oilgear units proved far superior to electric drives and mechanical transmissions under actual operating conditions.

**SMOOTH, POSITIVE SPEED VARIATION** "In order to obtain high efficiency in any boiler unit," says Mr. Morrow, "a very precise variable speed fuel feed drive is required to meet widely varying demand. The Oilgear Drive gives smooth, positive variable speed operation from zero to 100% of capacity with a straight line fuel feed characteristic. This allows us to calibrate the control system for operation within amazingly close limits of fuel-air ratio variation."

**EASE OF CONTROL** "Also, on this type of stoker the grate speed must be infinitely variable from minimum to maximum yet maintained in direct proportion to the rate of fuel feed. Every change in fuel feed requires an immediate and

directly proportionate change in grate speed. (Such synchronization) is easily obtained with the Oilgear drive units because of their ease of control, and the simplicity and low force requirements of the control mechanism."

**UNLIMITED SPEED RANGE** Also, fuel feed and grate drives must have a range of speed at least equal to the demand range. Most drives have a range not exceeding 4 to one. Yet at Racine, during the summer, demand drops far below the 25,000 lb. threshold imposed by such a ratio. The Oilgear Drives however have no "ratio" limits, would function down to zero load if necessary. In fact, they give precise load control down to a load of 15,000 pounds per hour normally obtained each day during the summer, and down to as low as 5,000 pph over the weekends still under full automatic control.

**OUTSTANDING RELIABILITY** "One of the outstanding features we discovered . . . was the reliability of the Oilgear units. The experimental installation operated almost continuously for a year and a half without any difficulty. This record was far better than we were able to obtain with any other type of drive or transmission."

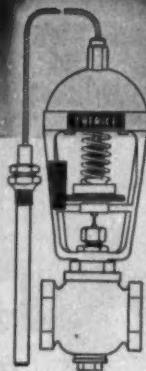
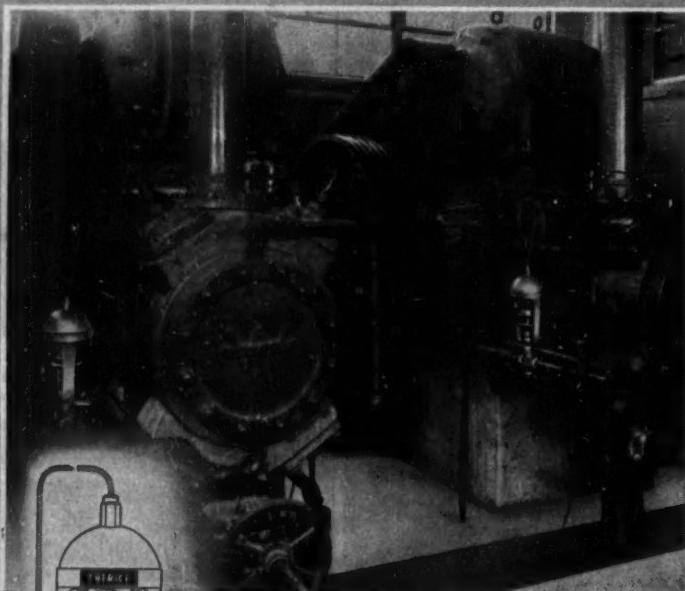
These four features, variability, ease of synchronization and control, actual range

Two Oilgear Variable Delivery Pumps with simple diaphragm actuated hydraulic servomotor lever controls supply fluid power for the fuel feed and grate drives. An Oilgear drive was experimentally installed on the fuel feed on the first stoker in 1948. On the basis of its performance, Oilgear drives were used for both fuel feed and traveling grate on a second stoker unit installed in 1949. Also, Oilgear will replace the mechanical grate drive on the first stoker installed in 1943. Like a shadow, flexible, controllable Oilgear Fluid Power causes fuel feed rate and grate speed to accompany steam demand up and down. Recording charts show steam demand varies "all over the place," but steam pressure and fuel air ratio stay steady.

from zero fpm, rpm or torque up to maximum, and reliability proven over and over again, are indications of the many advantages Oilgear drives and transmissions offer in machine design and use. Investigate Oilgear equipment as a *better* solution for your problems. THE OILGEAR COMPANY, 1579 West Pierce Street, Milwaukee 4, Wisconsin.

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You, too, can enjoy real savings like these. While this is a cold water application, it would be equally effective to control steam to hot water tanks, pasteurizers, pre-heaters, storage rooms, vats, plating tanks, cookers, feed-water heaters, water jackets, etc.

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### WHAT'S HAPPENING, cont. . .

be made at the rate of 5 million gallons per month.

The alcohol will be required as a result of the reactivation of four alcohol butadiene units at Louisville and Kobuta.

### St. Regis Now Operating New Kraft Mill in Florida

Production has started at the new Jacksonville, Fla., mill of St. Regis Paper Co. The mill turns out kraft pulp, paper and board. It can produce 100,000 tons of paper annually. This brings total capacity of St. Regis for kraft paper and board to 560,000 tons a year.

The new mill, on a 200-acre site just outside Jacksonville, is part of the long-range expansion of its southern operations by St. Regis. The goal is complete integration of kraft operations. Anticipating this, St. Regis has acquired sources of wood in Florida, Alabama, Georgia and Mississippi.

St. Regis owns or holds under long-term management contracts over 600,000 acres of timberlands in the South, of which about 300,000 acres are within a radius of 100 mi. of Jacksonville. Enough wood will flow from these holdings and come from other land owners in the area to keep the new Jacksonville mill running. At a capacity of 300 tons of kraft paper daily, the new mill will require about 175,000 cords per year of pulpwood.

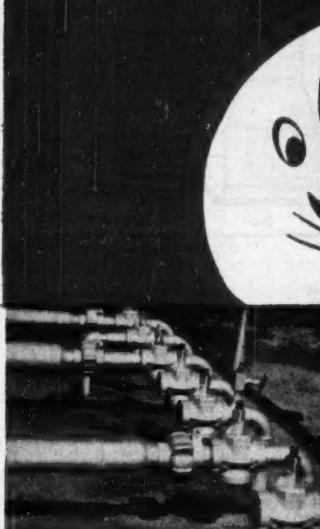
The fourdrinier paper machine at the Jacksonville mill, built and installed by the Beloit Iron Works of Beloit, Wis., has a wire 230 in. wide and 120 ft. long. It was designed for a top speed of 2,500 ft. per min.

Many unique features, used for the first time in paper mill construction, have been incorporated in the Jacksonville plant, from the handling of wood through to the finishing room. Close to \$1 million has been spent for installation of equipment to eliminate or minimize air and stream pollution.

Major expansion of capacity for kraft pulp, paper and board at its Pensacola, Fla., mill was completed by St. Regis in April 1952. At that time, a fourth machine began operating there. It can produce about 100,000 tons of kraft paper and board a year. This raises the capacity at Pensacola to 265,000 tons per year of kraft paper and board.

# FULL PIPE AREA

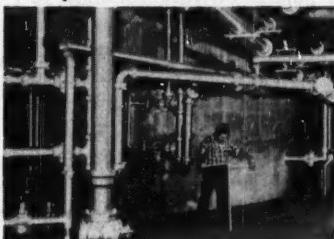
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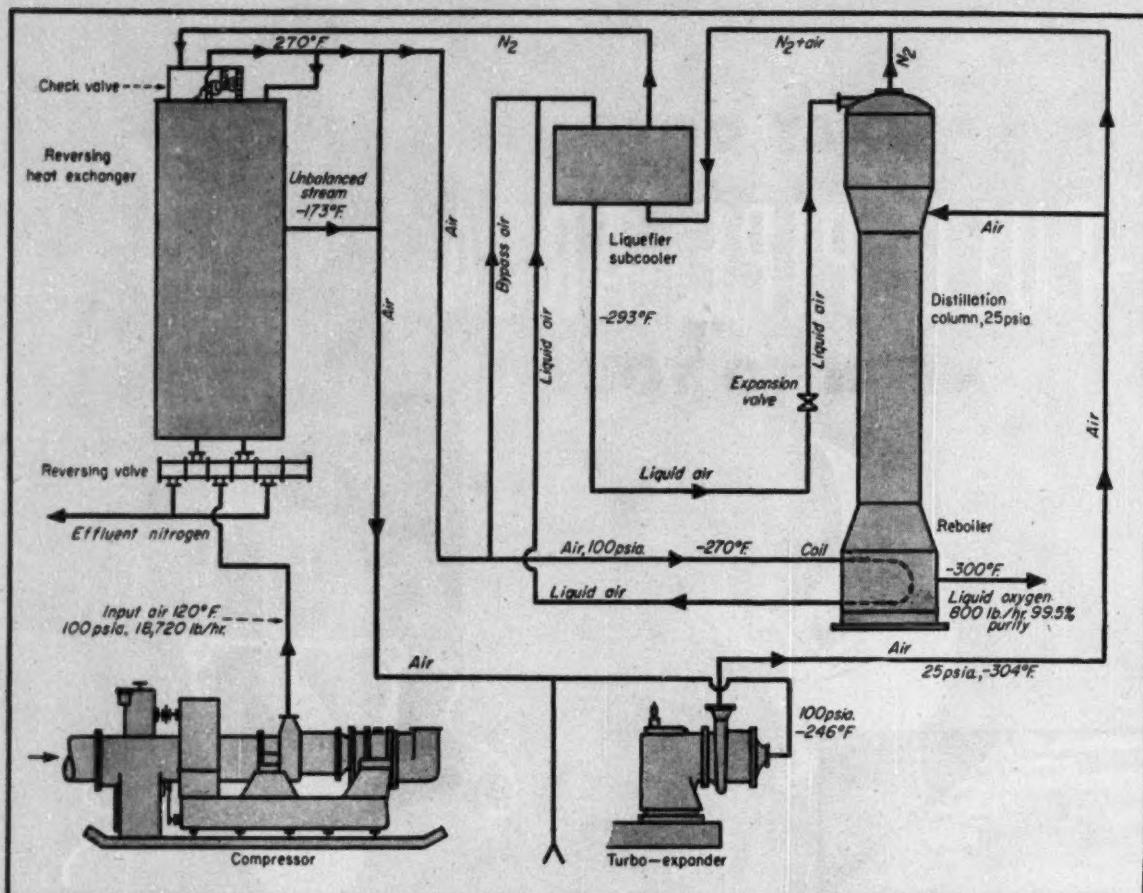
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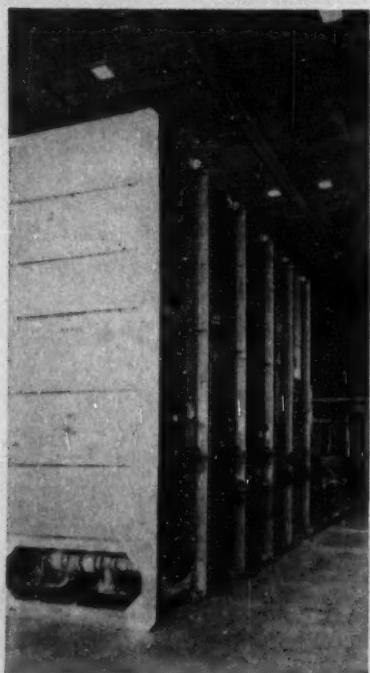
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UNIQUE unit minimum in size and weight, designed to come apart in sections for loading on to cargo planes, because . . .

## Liquid O<sub>2</sub> Unit Travels by Air

Designed for the military, this 10-ton-per-day generator will weigh only 35,000 lb., is self-sufficient, can be put up in 80 hr., has many engineering features.

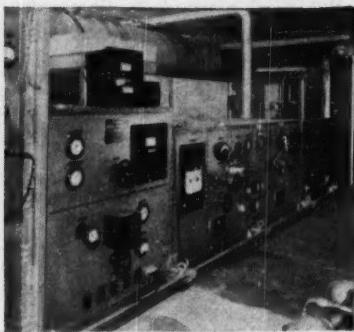


Chemical engineers usually don't design plants that are air-transportable. But then a good deal of common engineering practice was thrown out when the Air Force told Arthur D. Little, Inc., that it needed a new look in liquid oxygen generators for some of its work with guided missiles. The AF's research and development personnel reasoned that it would be more logical to generate its own than to transport liquid oxygen in truck and tank car lots.

According to its designers the new generator can't strictly be called a "modified Claude" unit or a modified anything else. Rather, Little's engineers prefer to designate the unit

as "a modern low-pressure oxygen plant incorporating reversing exchangers for clean-up of the incoming air." Here are some of the new ideas in this unit:

- **Self-Sufficiency**—Requires only fuel and lubricating oil. First such plant that needs no auxiliary cooling water.
- **Air-Transportability**—Several independent and complete packages go together to assemble the generator. Obvious corollary advantage is easy replacement of any major component. Entire unit weighs only about 35,000 lb. without the compressor.
- **Low Installation Time**—Takes only 80 hr. for complete assembly on previously prepared foundations.



FRONT view showing turbo-expander sections.

- Safe Operation—Maximum operating pressure is only 91 psig.
- Purity of Product—Variable at will between 95 and 99.6 percent oxygen.

The flowsheet above shows the essential elements of the process. Moisture and carbon dioxide are removed from the incoming air in the reversing heat exchanger\* while the air is being cooled by the effluent nitrogen. An unbalanced stream, characteristic of this type of precooling process, compensates for the differences in specific heats and mass flow rates of the air and nitrogen streams.

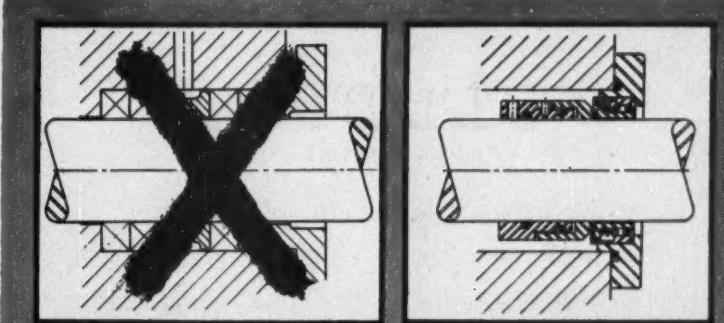
The reversing valves are actuated every 3 min. by an automatic timer, switching the channels through which the air and nitrogen flow. Impurities frozen on the channel walls during the previous cycle are picked up and carried out in the effluent nitrogen.

The turbo-expander is the source of refrigeration for the plant. Air at 246 deg. F is cooled to 304 deg. while expanding from 100 to 25 psia. The inlet temperature to the expander must be maintained high enough to avoid liquefaction in the expansion engine and the resultant loss in efficiency.

A portion of the exhaust from the expander is used as a vapor feed for the distillation column, and the remainder joins the nitrogen from the top of the column to supply the refrigeration for the heat exchange system. A bypass is provided around the reboiler coil, and control valves are located in the exit stream from the reboiler coil and in the bypass. These valves permit flexibility in the operation of the column by permitting a variation in the quantity of the air flowing through the reboiler coil.

(Continued)

\* For a complete technical description of the unique A. D. Little heat exchanger, see *Chem. Eng.*, Dec. 1949, pp. 104-7.



Stuffing box packing requires frequent maintenance.

Stuffing box packing causes shaft scoring.

Stuffing boxes require periodic tightening.

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ALKYL ACID PHOSPHATES  
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SODIUM CHLORATE

POTASSIUM CHLORATE

POTASSIUM PERCHLORATE

HYPOPHOSPHITES

OXALIC ACID

ZINC PHOSPHIDE

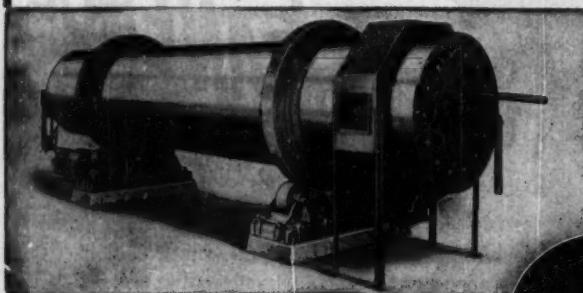
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Steam Tube, Hot Air and Direct Fire Dryers.

Water Tube and Air Coolers.

We mentioned at the beginning some of the obvious advantages of the unit to the AF. Here, now, are some of the more technical developments in this unit of interest to chemical engineers:

►1. **Gas-Turbine Compressor**—To the best of A. D. Little's knowledge, the proposed air source for the generator, consisting of a gas turbine-driven axial-flow air compressor, is the first attempt to use this type of prime mover for supplying air. It is considerably lighter in weight than any other source of compressed air. Although fuel consumption is slightly greater, for purposes of air transportability, the gas turbine is an ideal solution for the AF's problem.

Up to now this compressor has not been completed and tested; consequently, definite operating characteristics or an actual specific fuel consumption cannot be quoted.

►2. **Neatly Air Cooled**—Since any expansion engine must be loaded both for speed control and to remove energy from the expanding gas stream in the shaft work, the ADL generator incorporates a single-stage axial-flow blower as the loading mechanism driven by the turbo-expander. This blower supplies cooling air for the compressed air aftercooler and neatly solves the problem of doing away with cooling water and equipment.

►3. **Unique Piping Arrangement**—A particular feature contributing inherent flexibility to the operation is the unique piping arrangement around the reboiler and liquefier subcooler. As a result, this plant has been operated to produce liquid oxygen varying between 95 percent and 99.6 percent purity with no change in equipment, such as an increased height of column.

Part of the air leaving the heat exchanger system at 270 deg. F. is passed directly into the reboiler coil at the base of the rectifying column, where it is partially condensed, thus supplying heat for operation of the column. The mixture of gas-phase and liquid air leaving the reboiler coil passes through a control valve and thence to the liquefier subcooler. A bypass line, with its control valve, is piped around the reboiler coil and into the inlet of the liquefier subcooler. Judicious operation of these two control valves permits a variation in the quantity of air passing through the reboiler coil, thereby permitting considerable flexibility in the control

of the heat input to the column and allowing various purities of product to be drawn off. As far as is known, this is the first time a piping arrangement like this has been used.

► 4. Packed Column—The rectifying column in the ADL generator is a packed column using McMahon saddles. It may be the largest packed column of this type that has ever been used for producing liquid oxygen.

► 5. Liquefaction and Subcooling—The combined use of the functions of liquefaction and subcooling in one piece of equipment may or may not be unique to this plant; however, it does preclude the necessity of incorporating additional heat-transfer surfaces into the oxygen generator with the resultant savings in weight.

Here's how the ADL unit differs from the well-known small, commercial packaged units offered by several well-known manufacturers.

The small commercial units sold by one firm generally incorporate a high-pressure cycle, while the ADL unit is definitely a low-pressure cycle generator. Another company's packaged unit places the emphasis of its cycle on passing all the input air through the expansion engine with a head pressure of 150 psig. It does not incorporate a liquefier as a component part of the cycle, liquefaction taking place in the two sections of a double column. The third company's cycle compresses the input air to approximately 5 psig. only and achieves all refrigeration for the plant by auxiliary compression and expansion of a relatively closed cycle of dry, pure nitrogen gas.

► Energy Requirement—Inasmuch as the gas turbine-driven air compressor has not yet been tested and completed, no specific fuel consumption is known; however, calculating from the design consumption of 470 lb. per hr. of fuel, it is possible to derive a product-to-fuel ratio of 1.7 lb. of liquid oxygen per each pound of fuel consumed.

Because this compressor will not be available for use at the time the generator is scheduled to go into operation at Patrick Air Force Base, Little is supplying an auxiliary air source, consisting of diesel engine-driven rotary blowers. Although these are considerably heavier they will still be air transportable. The product-to-fuel ratio calculates to be 1.91 lb. of liquid oxygen per pound of fuel consumed.

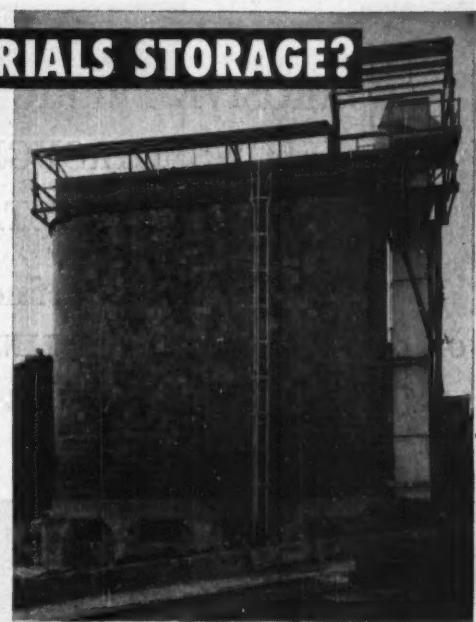
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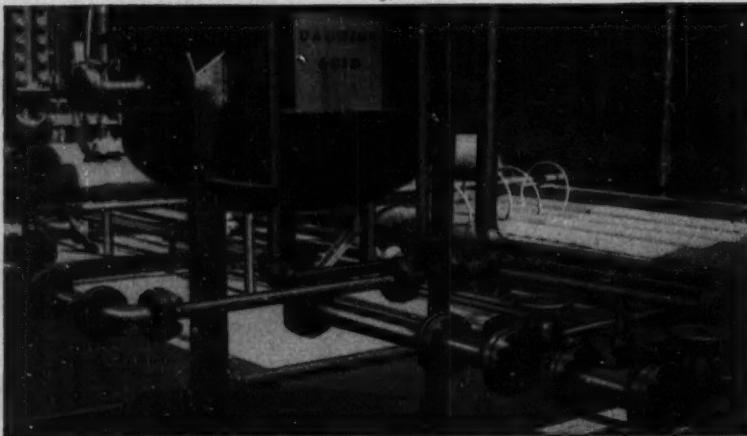


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resist corrosion and  
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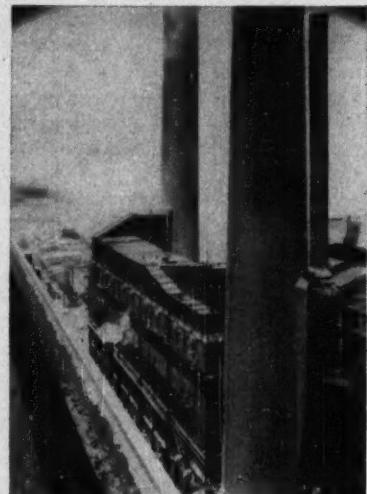
Some time ago, a large West Coast oil company investigated better methods to handle corrosive ferric chloride solution. The company's successful operation demands uninterrupted processing. Unscheduled "shutdowns" mean production pile-ups, lay-offs and heavy expense. Saran Lined

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OLD PRECIPITATORS with dry bottoms at Savannah mill of Union Bag. New one has wet bottom.

### Southern Pulp Mill Gets Wet-Bottom Precipitator

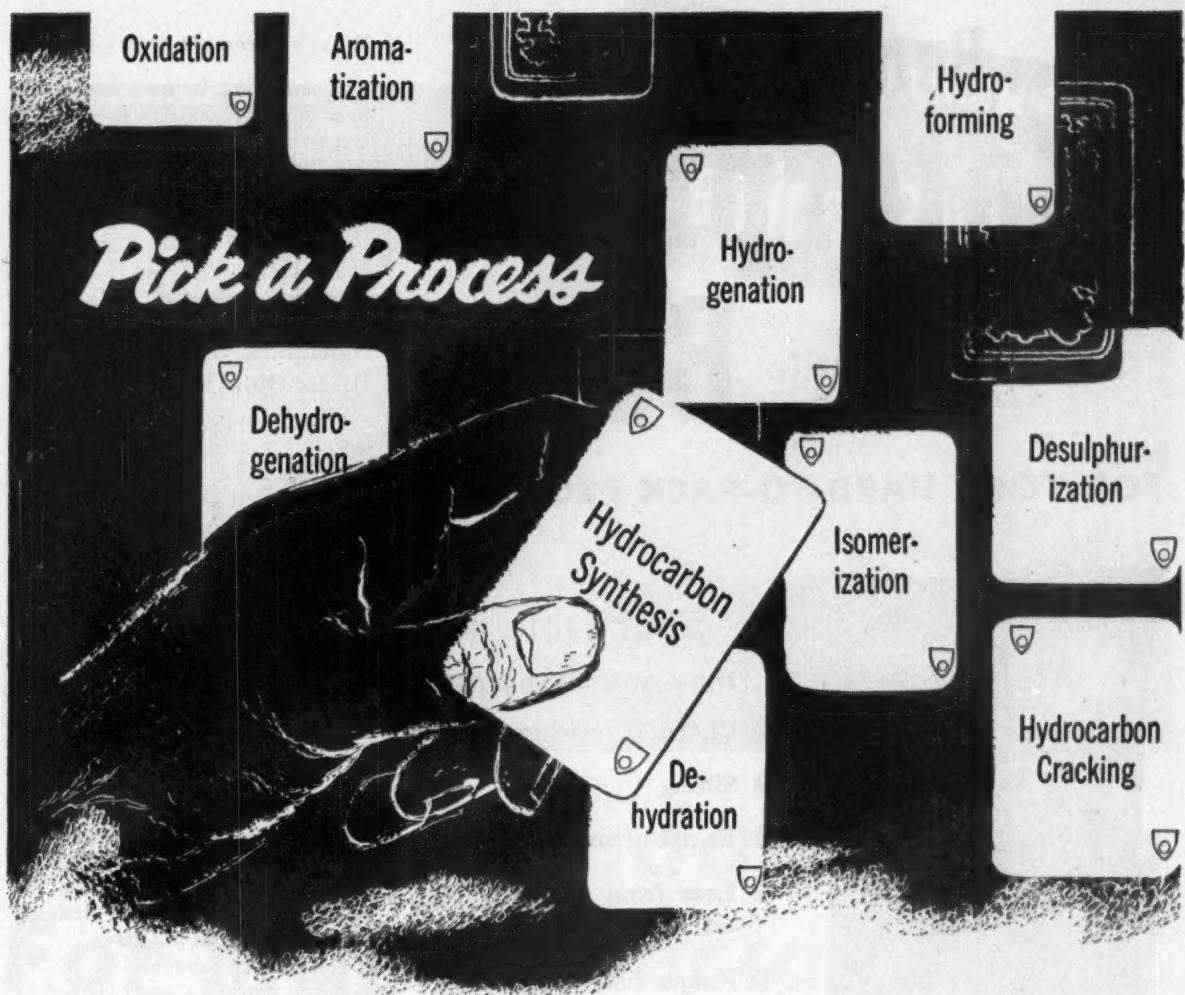
A new type electrostatic precipitator, which uses a wet-bottom flow method instead of a dry hopper and conveyor system for handling collected dust, has been installed at the Savannah, Ga., plant of Union Bag & Paper Corp. Other precipitators used by Union Bag are dry hopper types. The new wet-bottom precipitator is the first of its type installed at the Savannah plant.

A wet-bottom precipitator eliminates costs of auxiliary equipment required with a dry hopper. It also speeds return of collected material to the pulp-making process. The wet-bottom precipitator was recently designed by Research Corp. of Bound Brook, N. J., manufacturer of Cottrell precipitators.

The new precipitator at the Savannah mill will remove sodium sulphate from a spray-type black liquor recovery furnace handling 1,050,000 lb. of black liquor solids daily. The precipitator will clean 160,000 cfm. of gas at 275 to 300 deg. F. with a rated efficiency of 90 percent.

Five precipitators of the dry hopper type were originally placed in operation to handle gases from nine recovery furnaces. These furnaces treat a total of 3,240,000 lb. of black liquor solids per day at full load, representing a pulp production of 1,200 tons per day.

A sixth precipitator completed in 1950 and the new wet-bottom precipitator will clean gases from two spray-



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Whatever Kind of Bag  
You Need,  
WE MAKE IT!

## WHAT'S HAPPENING, cont. . .

type recovering furnaces handling a total of over 2,000,000 lb. of black liquor solids per day, equivalent to a daily pulp production of 700 tons. All seven precipitators, built by Research Corp., will handle a combined volume of over 875,000 cfm. of gas on full load at about 275 to 300 deg. F. with 90 percent rated efficiency.

## Naugatuck Doubling Output Of Its Ohio Vinyl Plant

Production capacity for vinyl resins will be doubled at the Painesville, Ohio, plant of U. S. Rubber's Naugatuck Chemical Division. The expansion, expected to be completed next June, will lift production to more than 50 million pounds a year.

In addition to expanding its resin capacity, Naugatuck has been developing new vinyls for the plastics industry. Facilities for their production will be included in the Painesville expansion.

## Catalytic Process Yields Polysilicon Chlorides

A new method for producing silicon chlorides, especially polysilicon chlorides, has been developed in the laboratories of the National Research Council of Canada in Ottawa.

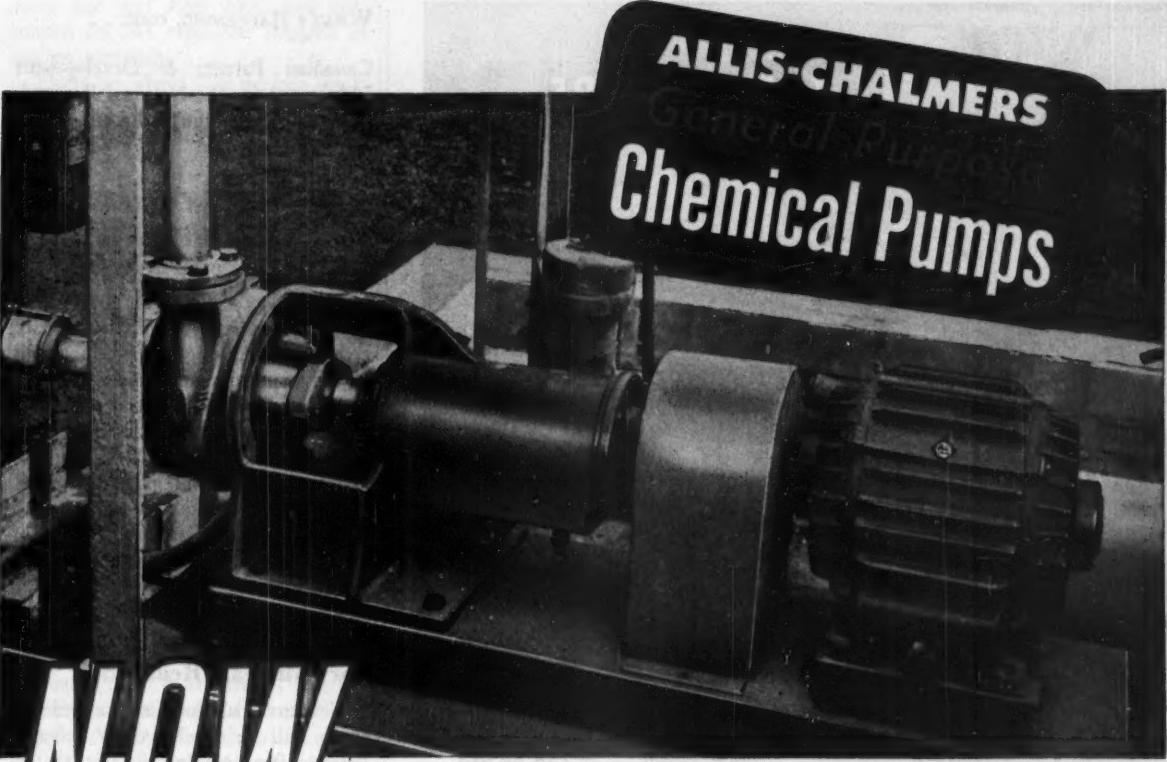
The process, developed by D. F. Stedman, provides a novel method in which a catalyst causes chlorine and silicon to react at a fast enough rate below their ignition temperature to produce higher chlorides with but little tetrachloride.

Silicon chlorides are highly reactive. For instance, after the chlorine has reacted the polysilicon chlorides offer the possibility of easy chain breakage and the introduction of other groups. This widens possible uses.

The new process could increase the output of silicon hexachloride, which has been obtained as a byproduct of tetrachloride production.

Demand for silicon chlorides is increasing as new products appear. A rain repellent developed by Stedman, for example, requires silicon chlorides for its manufacture. The repellent has been used to keep windshields of aircraft clear. Previously it worked at the high speeds of aircraft in flight, but it has been improved and may be useful at lower speeds, broadening its use.

Stedman's process for producing silicon chlorides will be licensed by



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SEE WHAT THIS PUMP can do before you order a costly "special purpose" chemical pump. It will do many of the jobs of a special pump, yet it costs hundreds of dollars less to buy.

It isn't meant to do every job in the chemical industry. But it will handle a big percentage of the jobs. Check the construction and design features that make this possible:

- It's built in most used ratings . . . to 1200 gpm, heads up to 250 ft.
- Handles liquids in most common temperature range . . . up to 550 F.
- Pumps liquors, corrosive materials and solutions, and petroleum products.

- Features double-row, oil lubricated bearings. Two oil rings running in generous reservoir of oil carry oil to bearings.
- Rigid cast iron pedestal supports pump body and holds bearings in alignment.
- Built in wide choice of materials including: iron, bronze, aluminum bronze, stainless steel, high nickel alloys and others.
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tiny beads solve problems in Measurement and Control of thermal, electronic and physical energy!

VECO Thermistors are made in the forms of Beads, Rods, Discs, and Washers — Stocked in a wide range of specific resistance values — or can be produced in quantity to your exacting specifications.

Distinguished from other sensing elements by extreme variations of electrical resistance with relatively minute thermal changes—approved and accepted by Government Agencies.

Victory's staff of engineers and physicists are ready to recommend the proper VECO Thermistor for • vacuum manometry • oscillator stabilization • temperature measurement • flow measurement • temperature compensation • surge protection • radar power measurement • volume limiting • gas analysis • temperature control • time delay • voltage regulation, as well as for any other new or unusual measurement or control application. Write today!

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**VECO DATA BOOK**

*Thermistors  
Analysis Cells  
Combustion Analyzers  
Varistors*

## WHAT'S HAPPENING, cont. . .

Canadian Patents & Development Ltd., agent for the National Research Council, with whom it shares quarters in Ottawa.

## Work Starts on Allied's New Chemical Plant in Texas

Construction has started on the Orange, Tex., plant of the Solvay Process Division, Allied Chemical & Dye Corp. Among first products will be ethylene oxide and ethylene glycol.

The new plant is located on a 650-acre site next to the Sabine River plant of Du Pont. Estimated cost of the first units is \$5 million. Austin Co. got the construction contract, and Spence & Howe Construction Co. of Port Arthur, Tex., a subcontract for initial work.

## Better Materials Sought For Nuclear Reactors

New materials for use in atomic reactors will be developed by Sylvania Electric Products Inc. in recently acquired facilities at Hicksville, Long Island, N. Y. New reactor materials are a major objective of intensified research Sylvania is undertaking for the U. S. Atomic Energy Commission.

Better materials will enable atomic reactors to operate at higher power levels, thus increasing their efficiency. Ability to operate at higher power levels, with greater energy output, would be of particular importance, for example, in the operation of a nuclear reactor for the production of electric power.

Materials for use in nuclear reactors must remain structurally sound at high temperatures and under intense bombardment by atomic radiation. In addition, they must not soak up the neutrons needed to continue the atomic chain reaction or to produce plutonium.

At Hicksville, new methods will be developed for the manufacture of reactor materials with the required physical and nuclear characteristics at reduced costs.

Because of the urgency of this research for AEC, the task of designing, building and installing equipment, as well as adapting the Hicksville buildings to their present use, was accomplished in less than five months. The facilities at Hicksville are housed in two main buildings, purchased by Syl-

vania last year after AEC had contracted for the expanded research in reactor materials.

There are about 200 persons working at Hicksville, about half of them scientists and engineers.

### Lukeweld Designs Packaged Solvent Extraction Plant

Mississippi Cottonseed Products will get the first of the new packaged filtration-extraction plants to be built by the Lukeweld Division of Lukens Steel Co. It will be located at Greenwood, Miss., and should be ready for operation by this June. Its capacity: 150 tons of cottonseed or 75 tons of soybeans daily.

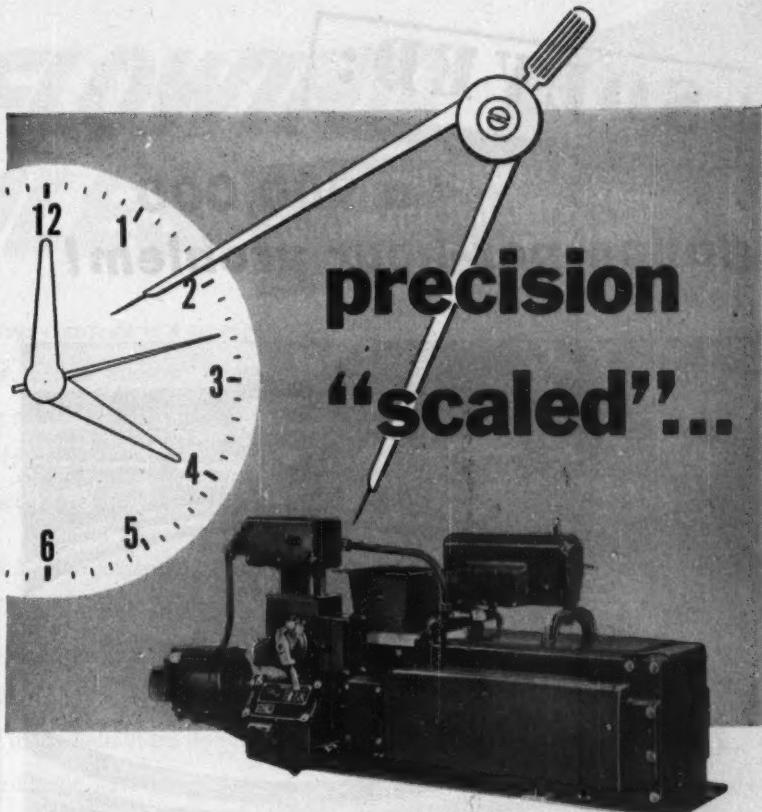
The plant removes oil from cottonseed and soybeans by solvent extraction. It was designed at the Coatsville, Pa., headquarters of Lukeweld. Its design is based on development work by the U. S. Department of Agriculture's Southern Regional Research Laboratory. Both Mississippi Cottonseed Products Co. and Osceola Products Co. cooperated in this research.

A large independent processor of cottonseed and soybeans, Mississippi Cottonseed Products operates 14 plants of varying capacities throughout the cotton growing regions. The economics of these new packaged units now permit crushers to take advantage of solvent removal of oil in smaller plants (under 300 tons per day) that are not large enough to adopt other costly solvent extraction processes.

By standardizing this new process in a series of small packaged plants (75, 100 and 150 tons per day) Lukeweld has spread the initial design expense over many units. The economies of the Lukeweld design enable the operators of small plants to compete with the low capital investment and unit processing costs of the large mills.

Another advantage is that small plants will no longer be restricted to an extraction season of about six months. The new plant will be able to process soybeans as well as other high oil-content vegetable seed. Through processing these other materials in off seasons, many smaller operators can now extend their processing season.

The Lukeweld units are planned to dovetail into present cottonseed oil plants. Each unit consists of the complete equipment for oil extraction, and can be installed between existing crushing rolls and meal sacking equip-



### FOR MINUTE TO MINUTE ACCURACY

Minute to minute accuracy in the feeding of dry materials — uniform delivery to reaction tanks, continuous blending, or batch mixing — is a requisite for maintaining uniformly high quality in final products, in modern chemical processing operations.

W & T Merchen Scale Feeders which weigh and feed in one operation ensure this exacting accuracy. Precision "scaled", durably constructed and simply controlled, the Feeder weighs all

material and immediately compensates by weight for variations in density, moisture content, etc. Whether feeding ounces or pounds per hour, the pre-set rate of feed is continually and automatically maintained.

If you have a processing problem requiring uniform feeding of dry materials, accurately controlled by weight, communicate with Wallace & Tiernan. You'll receive prompt attention without obligation.

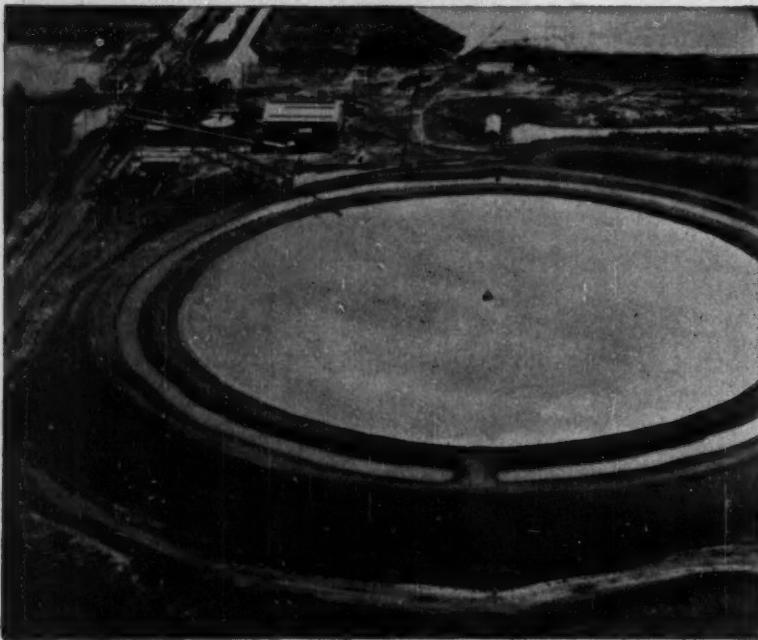
M-21

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# SOLVED:

## a 900,000 gallon-per-hour problem!



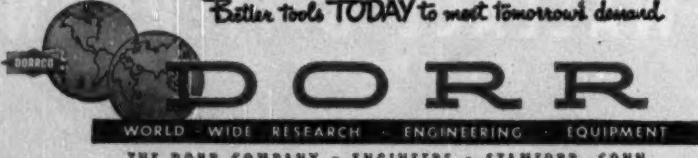
Largest installation of its kind in the world, this sedimentation unit handles 900,000 gallons per hour.

Problem was to clarify phosphate rock tailings carrying 2% solids — on a budget. Our answer, after thorough field study and testing, was this special 300 foot dia. Dorr Thickener mechanism installed in a 750 foot earthen basin. The results — economically accomplished — are an overflow suitable for re-use and an underflow thickened to 12-15% solids which can readily be impounded.

And sedimentation isn't the only unit operation where our specialized equipment and knowledge pays off.

Regardless of whether your process involves the separation of finely divided solids in suspension, the use of ion-exchange or fluidizing techniques, Dorr and its Associated Companies abroad can provide the right equipment for your specific job.

Better tools TODAY to meet tomorrow's demand.



### WHAT'S HAPPENING, cont. . .

ment. The packaged unit makes full use of existing delinting, dehulling, crushing and cooking equipment as well as buildings. The units are closed process systems, giving the operator the option of determining the amount of plant housing required in his specific location.

Estimating the total market for the Lukenweld-designed filtration-extraction plants, Vice President J. Frederick Wiese says, "Probably more than half of the cottonseed oil plants in operation could benefit from the installation of these packaged extraction units."

### More Potassium Sulfate To Come From Carlsbad

A substantial addition to its potassium sulfate plant at Carlsbad, N. M., is planned by International Minerals & Chemical Corp. The plant site has already been laid out and construction will start within the next few months.

Added production resulting from this expansion will amount to about 35,000 tons of potassium sulfate a year. The plant will be in production around the beginning of 1954.

"Need for the new plant," says Vice President A. Norman Into of International's Potash Division, "was dictated by agricultural demand, which has never been entirely satisfied. Our planned additional facilities will help to make the United States independent of foreign imports of sulfate of potash."

### Ethylene Polymerized With Alcohols to Oils and Waxes

Solvent polymerization of ethylene at pressures up to 20,000 psi. has been carried out in a continuous laboratory unit by E. R. Gilliland and R. J. Kallal of MIT. Products range from oils to hard waxes.

The system includes a 360-cc. steam-jacketed reactor, solvent and ethylene pumps, semi-automatic letdown valves and metering equipment.

Ethylene is continuously recycled, together with the required make-up, at a total rate up to 400 g. per hr. Solvent up to 1,000 g. per hr. is used on a once-through basis.

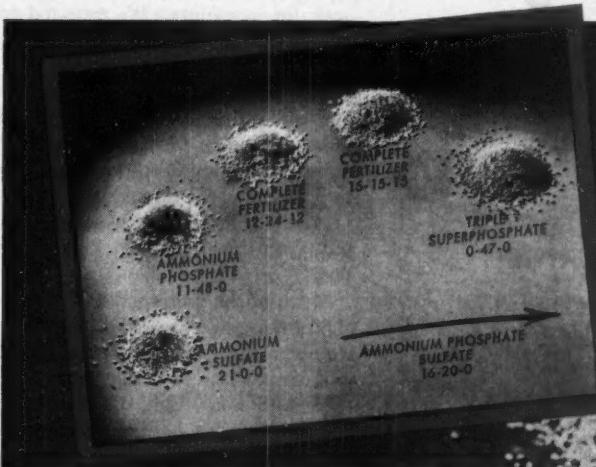
At pressures ranging from 1,000 to 8,000 psi. and at temperatures from 120 to 190 deg. C. ethylene is polymerized in the presence of methyl, ethyl,

# FREE-FLOWING GRANULES

IMPORTANT CHARACTERISTIC OF  
CONCENTRATED FERTILIZERS PRODUCED  
BY DORR-DESIGNED PLANTS

These chemical fertilizers will never compact in a storage bin nor clog a farmer's spreader. Their uniform, round granules will remain free-flowing and dustless until used . . . thanks to the exclusive Dorrc Fines Recirculation System employed in their production.

This is the only System which can interchangeably produce triple superphosphate, ammonium phosphates and sulfate or complete concentrated products in a 100% granular form of exceptional uniformity. It is but one of the many innovations introduced in the field of phosphatic fertilizer production by Dorr during the past 35 years.



It will pay you to check Dorr's complete facilities, ranging from laboratory testing through plant design and construction. Write for Bulletin #8000, or better still, let us send an engineer to discuss your problems from the standpoint of economics and process. No obligation, of course.





## **WILSON *Pistol Grip*** **hits the smallest target**

Cleaning small tubes is often a difficult production problem in refinery and chemical plants. But Wilson Engineers have developed a fast, efficient, low-cost solution in the Pistol Grip Tube Cleaner, which thoroughly removes deposits from tubes as small as  $\frac{1}{4}$ " ID. This production tool is another Wilson first in tube cleaning equipment. • The Pistol Grip weighs only 3 lbs — no more than a 12" Stillson wrench. It provides the operator with one-hand control for cleaning small, straight tubes of  $\frac{1}{4}$ " to 1" ID in sterilizers, hot water heating units, lube oil heaters, oil pre-heaters, heat exchangers and other small bore tube apparatus. Write for Bulletin 1046.

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### WHAT'S HAPPENING, cont. . .

isopropyl and t-butyl alcohols, with tertiary butyl peroxide as the initiator.

Only the primary and secondary alcohols are active chain transfer agents; products comprise the original alcohols with one or more molecules of ethylene entering between the hydroxyl carbon and any or all hydrogens on the hydroxyl carbon. Tertiary butyl alcohol does not enter into the polymerization reaction.

Polymerization rates increase with increasing temperature, pressure, ethylene purity, and peroxide concentration. The rates are also much higher with the primary and secondary alcohols than with tertiary butyl alcohol. Molecular weight increases with the pressure and with a decrease in temperature and peroxide concentration.

### New Sulfate Pulp Mill Being Built in Texas

Construction of the new mill of East Texas Pulp & Paper Co. at Evadale, 15 mi. north of Beaumont, will begin this month. The mill will produce bleached sulfate pulp and paperboard, but no newsprint or paper stock for magazines. It's expected to be in operation before the end of 1954. Its capacity: 250 tons a day.

East Texas Pulp & Paper was organized by the Houston Oil Co. and Time, Inc., each of which own equal stock in the new enterprise. Financing has been arranged through the Northwestern Mutual Life Insurance Co. and Chase National Bank in New York.

Much of the pulpwood will be supplied by the Southwest Settlement & Development Corp., a wholly-owned subsidiary of the Houston Oil Co.

H. A. Simons, Ltd., of Vancouver, British Columbia, has been engaged to design and build the new sulfate pulp mill.

### Transparent Plastics Made From Itaconic Acid Esters

Plastics from itaconic acid have possibilities as transparent windows of military aircraft and for military optical instruments, the Northern Regional Research Laboratory of the U. S. Department of Agriculture at Peoria, Ill., reports.

Transparent plastics of the thermoplastic type can be made by copolymerizing itaconic acid esters with

methacrylates, vinyl chloride, or acrylonitrile. These plastics have higher flexual and impact strengths than other plastics that do not contain esters of itaconic acid.

The itaconic acid is now being made on a pilot-plant scale from anhydrous glucose. USDA estimates the acid can be made for about 27c. a lb. in a plant producing 3 million pounds annually. Cost of plant: \$800,000.

### Du Pont Begins Expansion To Boost Titanium Output

Du Pont is expanding facilities for the production of titanium sponge at its Newport, Del., plant and will soon begin a similar expansion at its Edge Moor, Del., plant.

This expansion, undertaken for the government, will yield about 13,500 added tons of titanium sponge during the next five years. At Newport the expansion will include a main manufacturing building and a finishing building. A new power house, office building and laboratory will be added. Work should be completed about the middle of 1954.

No new buildings are planned at the Edge Moor plant. Construction will consist of additions to present structures.

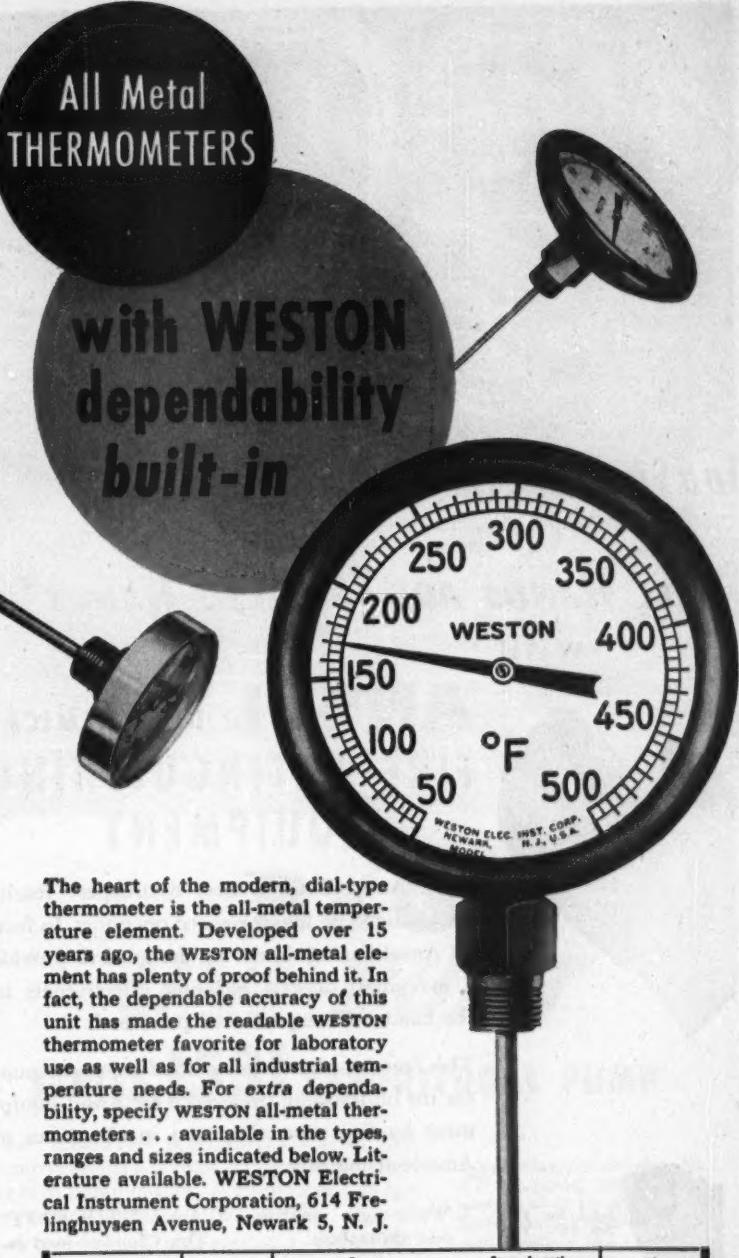
Titanium metal has great potentialities for defense as well as commercial applications. Alloys of the metal are stronger than some present steels and 40 percent lighter. Titanium alloys are highly corrosion resistant, especially to salt water. Before the Korean war, only pilot-plant quantities of titanium sponge were produced.

### Doubling Output Not Enough To Meet Polyethylene Needs

Production of polyethylene doubled last year, bringing present output to almost 125 million pounds annually. Producers expect to triple current production by 1955.

Manufacturers of plastics believe polyethylene will become the world's most important plastic. Only 10 years old, the plastic always has been in short supply until this year.

The high-molecular-weight material will compete in six major fields. They are packaging film, bottles and jars, injection molded products, cable, wire and electrical use, large diameter piping for such uses as irrigation, and as coatings for metal and fiber drums. In addition, polyethylene of low mole-



The heart of the modern, dial-type thermometer is the all-metal temperature element. Developed over 15 years ago, the WESTON all-metal element has plenty of proof behind it. In fact, the dependable accuracy of this unit has made the readable WESTON thermometer favorite for laboratory use as well as for all industrial temperature needs. For extra dependability, specify WESTON all-metal thermometers . . . available in the types, ranges and sizes indicated below. Literature available. WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

Type	Scale Length	Ranges		Stem Length		% Accuracy of Thermo. Range
		As low as	As high as	As short as	As long as	
Heavy Duty Straight Form	9"	-100F	+1000F	2½"	48"	1
Heavy Duty Angle Form	9 or 12"	-100F	+1000F	2½"	72"	1
Standard Angle Form	6"	-100F	+1000F	2½"	72"	1
General Purpose	4½"	-100F	+1000F	2½"	36"	1
Laboratory	3.40"	-100F	+500F	2"	24"	½ of 1

**WESTON Instruments**



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**ALL HANDS ARE "SKILLED HANDS"**

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## **ANSUL DRY CHEMICAL FIRE EXTINGUISHING EQUIPMENT**



With Ansul Extinguishers near-expert results are obtained by inexperienced operators. In fact, all Ansul Extinguishers are designed to provide a maximum of extinguishing effectiveness in the hands of inexperienced personnel.

This feature, plus benefits listed below, account for the outstanding preference for Ansul Equipment by fire protection men in all phases of American industry.

1. Water-tight construction throughout.
2. Easy on-the-spot Re-charging (No tools needed.)
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4. Special cartridge guard protects cartridge . . . rugged construction throughout.
5. Ansul "PLUS-FIFTY" Dry Chemical used exclusively.
6. Corrosion resistant construction throughout.
7. Greater fire-stopping power.
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Send for File No. 834. You will receive a variety of helpful printed

matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped Systems and Ansul 2000 lb. Stationary Units.

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### WHAT'S HAPPENING, cont. . .

cular weight may be used as a wax additive and in some coatings.

### El Paso Refinery Gets New Houdriflow Cracker

A Houdriflow catalytic cracking unit, with a capacity of 11,500 bbl. per day, recently went into operation at the El Paso refinery of Standard Oil Co. of Texas.

Part of the present expansion by Standard of Texas, the new unit, begun over a year ago, was engineered and constructed by Catalytic Construction Co. of Philadelphia. Houdry Process Corp., also of Philadelphia, developed Houdriflow cracking.

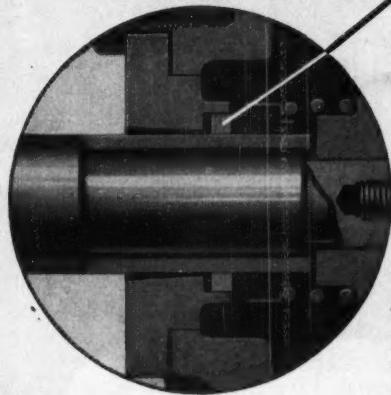
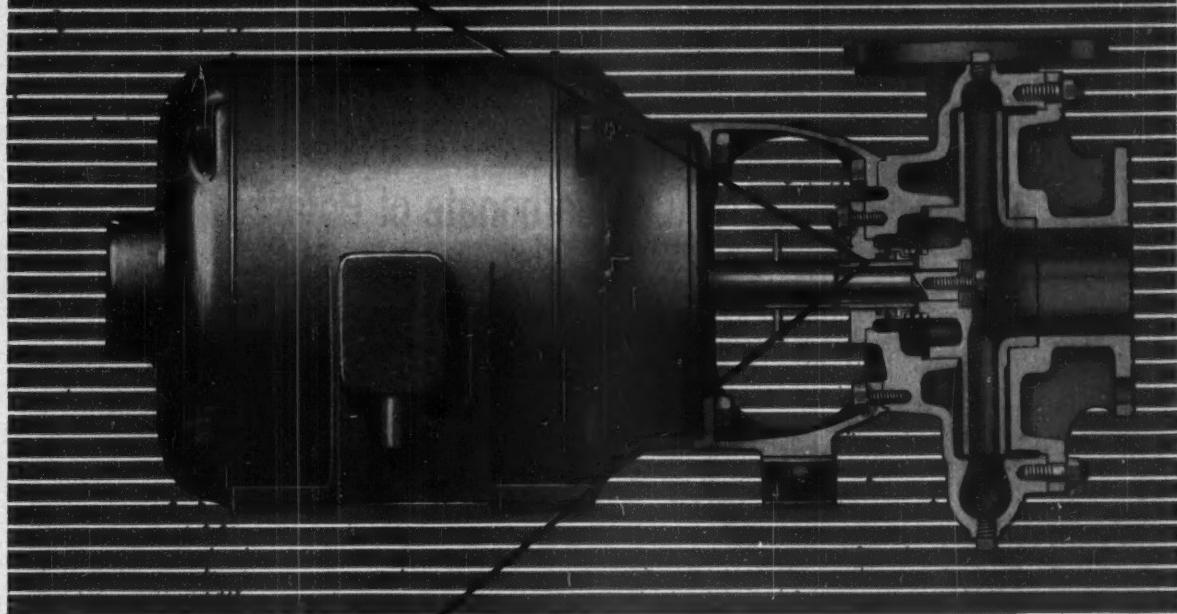
**Ethanol:** Commercial Solvents Corp. has increased the base price of ethyl alcohol to 55 c. per gal. in tank cars in the East and to 65 c. per gal. in the West. Quantity and formula differentials are maintained. By this action, Commercial Solvents brings alcohol back to its base price before Nov. 10, 1952.

**Food Yeast:** Monsanto has made an annual grant to the University of Maine for research on the growth of food yeast on ammonium sulphite waste liquor. The project will investigate the possibilities of producing high-protein yeast from the waste liquor.

**Monostyrene:** Foster Grant Co. of Leominster, Mass., has purchased a 100-acre site at Orange, Tex., for a monostyrene plant. Construction is just getting under way, and the first unit should be completed in about 15 months. Monostyrene will be shipped to the company's plastics plant in the Northeast. Other chemical products may eventually be produced at the Orange plant, which is about two miles northwest of Du Pont's Sabine River works.

**Conjugated Aliphatics:** Du Pont chemists have come up with a new and expeditious way to make highly conjugated aliphatic compounds. Acetylene is condensed with an acrylic derivative. Condensing acetylene with methyl acrylate, for example, gives a high yield of methyl 2, 4, 6-heptatrienoate, a new compound. —End

# NEW Remite SEAL ENDS LEAKAGE TROUBLES



Cross-section showing Remite Mechanical Seal.

Note the pump shaft . . . super-finished high grade steel . . . oversized for minimum deflection . . . quiet. The impeller is of sound hydraulic design, mechanically balanced, with balance ring and relief holes to reduce thrust. The heavy duty ball-bearing motor is normally furnished as drip-proof, but is also available in splash-proof, totally enclosed and explosion-proof models.

B & G Series 1531 Uni-built Pumps are made with capacities to 1200 GPM, heads to 400 feet.

## B & G UNI-BUILT

### SERIES 1531 CENTRIFUGAL PUMP

The "REMITITE" Mechanical Seal of this pump presents a revolutionary new development in pump design . . . eliminates leakage . . . assures long, trouble-free life.

A carbon seal ring faces on a "REMITITE" floating seat—a new type of material, so hard it will scratch glass—wear-proof and corrosion-resistant! This Seal is self-lubricating.

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new chapters to the continued story of chemicals in industry.

## NIALK® Carbonate of Potash

Unsurpassed for purity and uniformity, NIALK Carbonate of Potash is widely used in the development and production of glass of exceptional clarity and freedom from flaws for both optical and decorative use.

Strict production standards plus continuing application studies have earned for this NIALK product—as for every NIALK product—industry's unqualified acceptance.

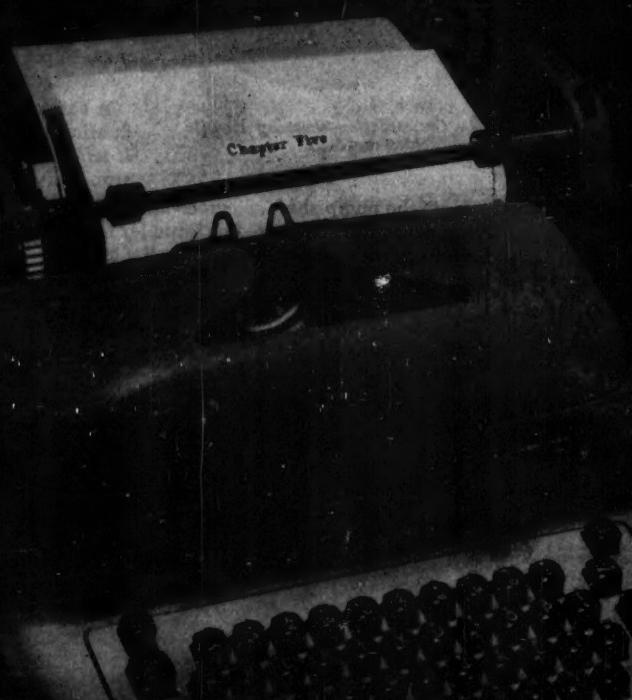
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CARBONATE OF POTASH    LIQUID PARACHLOROPHENZENE  
CAUSTIC SODA    LIQUID POLYETHYLENE  
LIQUID TRICHLORO PHthalic ANHYDRIDE

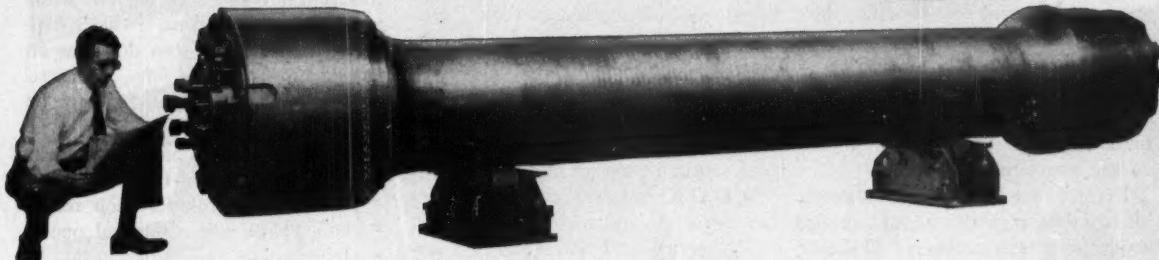
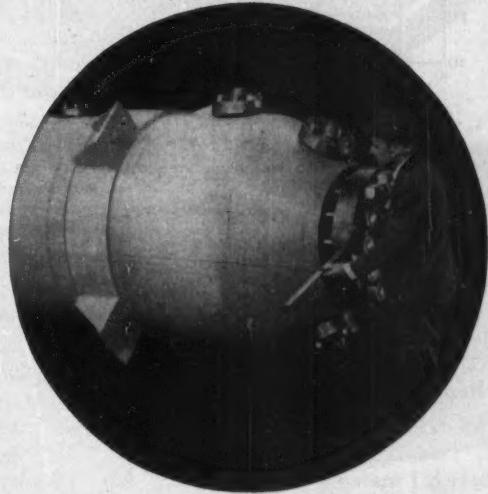
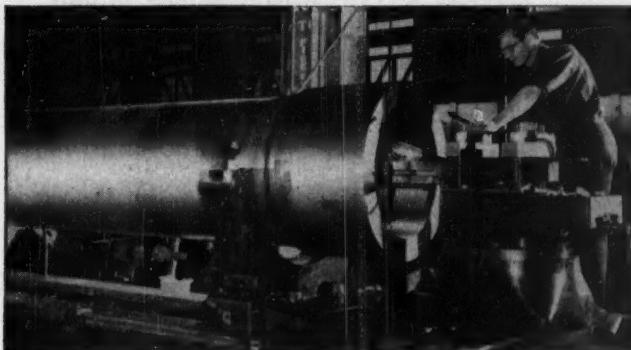
Chapter Two





**ALL HERE UNDER ONE CONTROL...**

## *Everything Needed for a Good Pressure Vessel*



A good pressure vessel is more than a big forging machined to proper size and shape. It is design, engineering, metallurgy, steelmaking, forging, heat-treating, machining, and testing—all rolled into one. And there is no room for error at any point along the route.

Here at Bethlehem we're a little bit proud of our set-up for building pressure vessels and following through on every detail at every step. And we're pleased, too, that some of the world's greatest chemical firms employ us to build vessels for them. It rather shows, we think, their confidence that Bethlehem can be relied upon to do a real job . . . from the blueprint stage to the final inspection.

The Bethlehem shops produce forged-steel vessels of almost every size and type: reactors, filters, converters, separators, high-pressure accumulators, large autoclaves, etc. These can be of single- or multiple-section design,

whichever the plans require. Needless to say, their quality is protected by many safeguards, including a series of close metallurgical checks by our technical men.

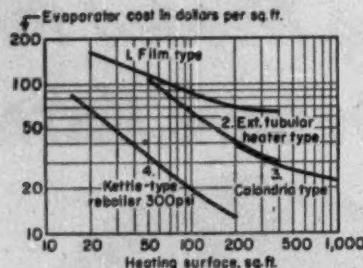
We hope you'll call us the next time you're planning pressure vessels—whether one, or two, or a whole battery. Our engineers will work smoothly with your own headquarters staff, and our shops will build the units you want to the specifications you give us.

**BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.**

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



# Pro and Con



1. Mild steel, without accessories. Accessories on mild steel unit add about 20 percent. Construction in stainless-clad steel increases costs by a factor of about 1.5. Accessories on stainless-clad add about 15 percent.
2. Stainless steel, no piping, vacuum apparatus or accessories.
3. Stainless steel, no piping, vacuum apparatus or accessories.
4. Carbon steel, without accessories or piping.

## Report on Evaporator Costs

Sir:

I would like to report on the survey which I made on evaporator costs. I sent out 55 queries to companies manufacturing evaporators of all types. This was done on July 31, 1951.

There were 32 replies. Only three gave any information of the type desired. Rounded-off figures are plotted on the graph (above).

I regret that I am unable to assemble cost data in greater amount, greater variety or greater accuracy. However, I hope that these figures will help some of your readers in their work.

This is a beautiful example of why good cost data are so important in magazines like yours. . . .

GORDON C. WILLIAMS  
Head, Dept. of Chemical Engineering  
University of Louisville  
Louisville, Ky.

► We feel as badly as Prof. Williams does that his survey, undertaken at our request, was not more productive. Other recent surveys of costs of various types of process equipment have yielded valuable articles; some have already appeared in CE, more will come.—ED.

## 67—With More to Come

Sir:

The January issue of Chemical Engineering, which contains a number of worthwhile articles on the subject of costs and methods of estimating

costs, has just come to my attention. I can't recall ever having seen anything comparable to them in any other chemical or engineering journal. . . .

If you have published similar articles in previous issues I would appreciate your sending me the references at your very earliest convenience.

ALBERT J. BOOTH

Technical Director  
Vancouver, B. C.

► We sent Director Booth a list of the 67 articles (some 219 pages) that we've published since 1946 on the theme of "costs and methods of estimating costs." And we promised him at least four more within the next few months.—ED.

## Amen on Sour Estimates

Sir:

I wish there were something I could contribute to your January article "Where Cost Estimates Go Sour." But all I can say is "Amen."

Chaplin Tyler has shown he understands and appreciates today's estimating problems. Of course, estimating "right on the nose" isn't easy and I am often reminded of friendly "joshing" (yet I can't help but feel that it's really meant) that I get from our research gang when we talk about the G.O.K. factors, the contingency—or factor of ignorance as you call it.

In retaliation I frequently find myself wanting to say, "Well, why did you pull out so much equipment when the final estimating chips were all down." But somehow I never really do, for one does the best job of estimating he can and that's about it. Of course, there's no worse mistake than that of not learning from each job how to do a better one the next time.

When you get right down to it, estimators work from all the facts they can put their hands on. Opinion is bound to creep in; but by and large the information they work with (whether it be facts or opinion) really reflects how well studied the new construction project is from the company standpoint—not solely from the estimator's or the research department's standpoint. Any learning that is to be had should be to the company's benefit.

As a whole, we have learned a lot

in our company about estimating and always shall continue to shoot for the "ideal." But I can't help but admit we're fallen victims in all areas pointed out by your article—in varying degrees, to be sure.

THOMAS M. WARE

Vice President  
Engineering Div.  
International Minerals & Chemical Corp.  
Chicago, Ill.

► Author of the article "Where Cost Estimates Go Sour" in our January issue (p. 198-200) was Du Pont's Chaplin Tyler, well known for his book "Chemical Engineering Economics." Years ago he was a member of our own editorial staff.—ED.

## Your Dollar's Slipping, Too!

Sir:

Seldom have I read an article with more interest and profit than the one in February entitled "An Engineer's View of the Dollar." Mr. Steele's fresh outlook and keen analysis made me realize—with alarm—what's happening to the American dollar as an engineering tool.

I particularly like the challenge he throws out to engineers: ". . . we should sharpen our engineering wits and think more in terms of basic costs . . . and work for their reduction." That's where the real opportunities lie.

FRANK A. SYMONS  
Chemical Engineer  
E. St. Louis, Mo.

► Author Steele emphasized a basic theme brought out in another way by the now-famous Paley Commission: The threat facing the U.S. is the insidious rise in the real costs of materials, with consequent lowering of our standard of living.—ED.

## Manhours Per Square Foot

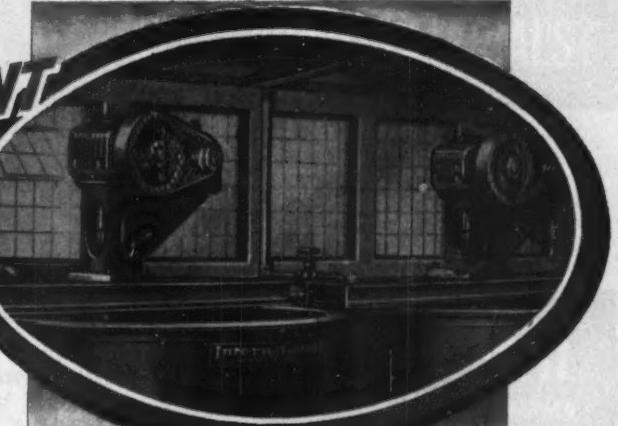
Sir:

Some of the notes I made as I read your January article "New Correlation of Engineering and Other Indirect Costs" may be of interest. They are given below.

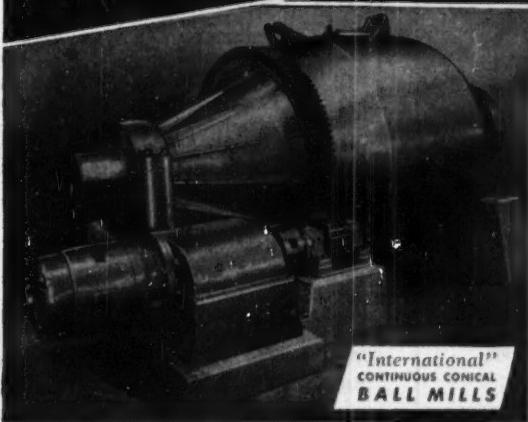
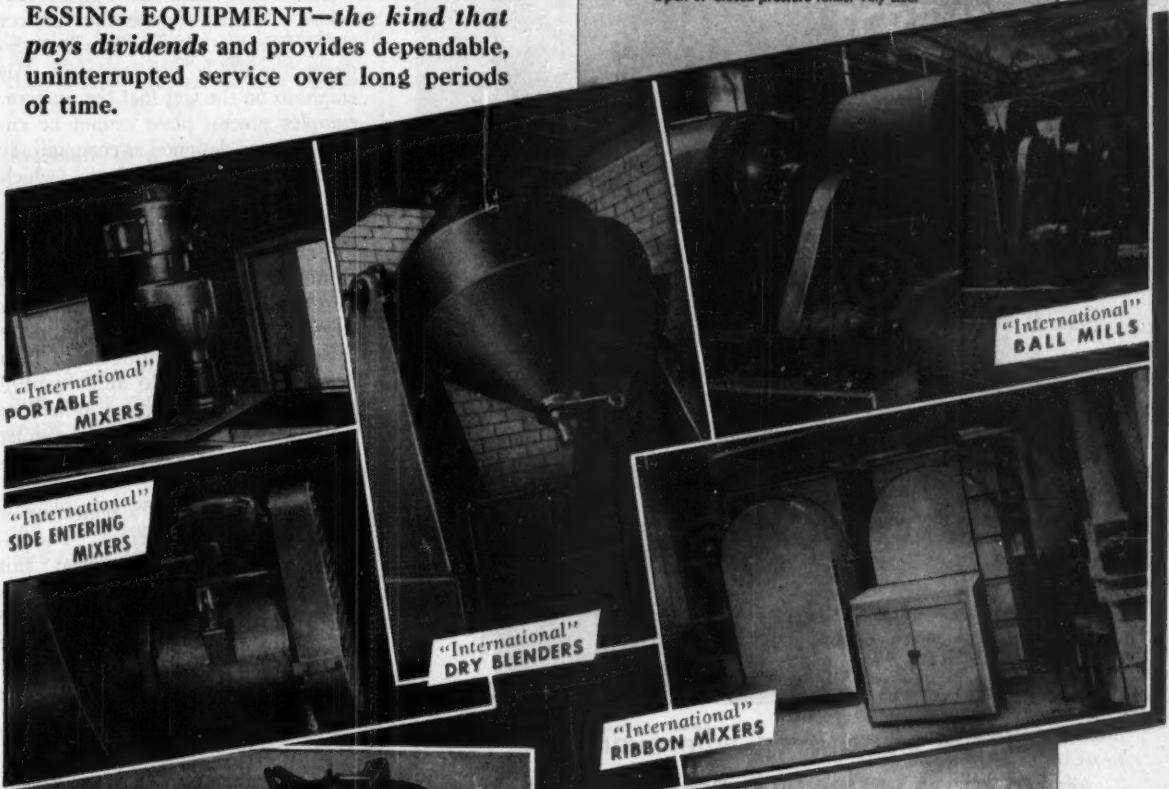
Mr. O'Donnell states that average productivity for design and drafting (as measured by hours per construction-drawing) ranges from about 95 to 115. Presumably he is talking

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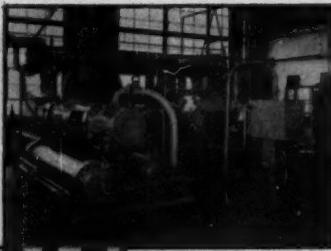
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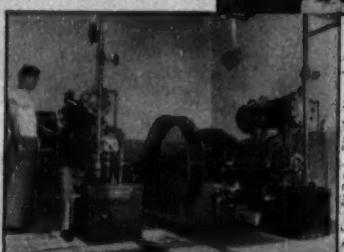
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### PRO AND CON, cont...

about an average-size drawing with a square footage of about 5. If so, this means that the manhours per square foot are on the order of 20 to 25.

This figure is a rough check against a very large amount of data which I assembled at one time. The average was also 20 to 25 manhours per square foot, but the range was as low as 15 on some jobs to as high as 45 on others. In every case, however, the very high or very low manhour figures were based on special considerations which a good estimator would have taken into account in preparing his total engineering estimate.

Mr. O'Donnell points out the tendency to underestimate the indirect costs of process plants. This is a tendency it would be well to correct. His emphasis on the fact that the modern, complex process plant cannot be engineered and designed as economically as more conventional plants (which are more or less repetitive in nature) is a worthwhile point to note.

Under "Total Engineering," the author lists the many things which go into the scope of the work and costs covered by this item. However, there is no mention of contingency. It is often good practice to apply contingency to total engineering as well as materials and labor. This is similar to splitting the fee between engineering and construction.

One item of total engineering is supervision of construction. The author carefully explains what this means and distinguishes it from construction supervision. In this way he eliminates what is sometimes a source of confusion.

HANS J. LANG

Process Engineer  
C. F. Braun & Co.  
Alhambra, Calif.

► Many of our readers, we feel sure, will be glad to get these new figures on the design and drafting manhours it takes to complete a square foot of drawing. On a dollar-and-cents basis, the average cost would seem to fall within the range of \$75 to \$125 per sq. ft.—Ed.

### Blessed on Two Counts

Sir:

Please rate me among the host of well-wishers who call you blessed for the work of digging out of obscurity such a long-hidden gem as O'Donnell's "New Correlation of Engineer-

ing and Other Indirect Project Costs" in your January issue . . .

. . . as well as that equally erudite bit of artful sarcasm "How to Write Poor Letters." I could buy that man the best drink in the house for daring to upset the staid old apple-carts of our college epitaph polishers. Let's live by writing as we speak, not bound by the rusty chains of stiff formality.

PAUL C. ZIEMKE

Safety Engineer  
Oak Ridge, Tenn.

► All credit for the "cost" article goes to Jim O'Donnell himself, who heads up the New York firm of project engineers bearing his name. His article is looked upon as something of a pioneering effort in its field; it helps fill a big gap in the chemical engineering "cost estimation" literature.

As for Assistant Editor Reeves's "How to Write Poor Letters," the bouquets and the brickbats are still coming in. So far, there're three bouquets for each brickbat. Not a bad ratio?—ED.

### Estimate in a Hurry

Sir:

I was glad to see "How to Estimate Costs in a Hurry" by Henry E. Wessel in the January issue of Chemical Engineering. In my opinion this is a worthwhile contribution to commercial chemical development. I would appreciate having 25 reprints for distribution to my class at Columbia in my course "The Business of Chemical Engineering" . . .

This field of the economic appraisal of chemical projects is relatively new and its terminology is still developing. This might be a good time to attempt to define and clarify the various terms used in this field in order that various contributors might use the same terminology in their publications. I believe it would be helpful to have an agreed definition of manufacturing cost or mill cost. Also sometimes confusion arises as to the distinction between amortization and depreciation and it would be helpful if this were clarified.

In Table 5, I presume that Mr. Wessel has included employee benefits in his labor cost. This is an element which younger engineers taking up appraisal work commonly overlook. Another question is on maintenance. Does this item in Table 5 cover both materials and labor or maintenance materials alone?

With the information Mr. Wessel provides, early-stage economic appraisals of new chemical projects can be approximated. Even if the accuracy of

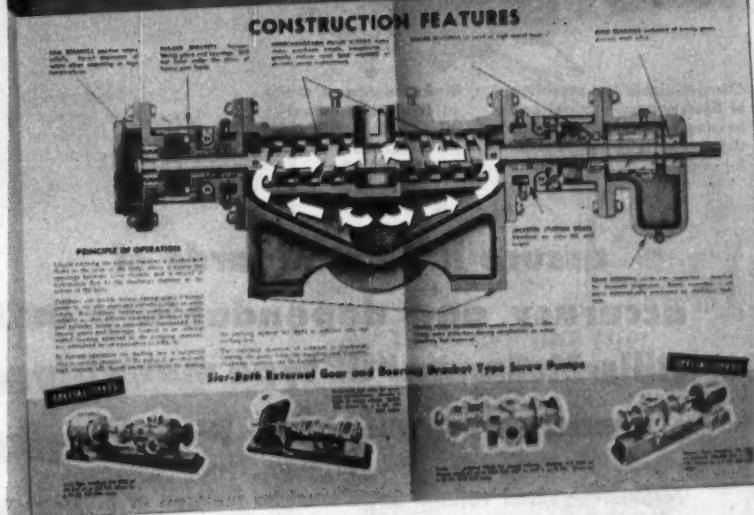
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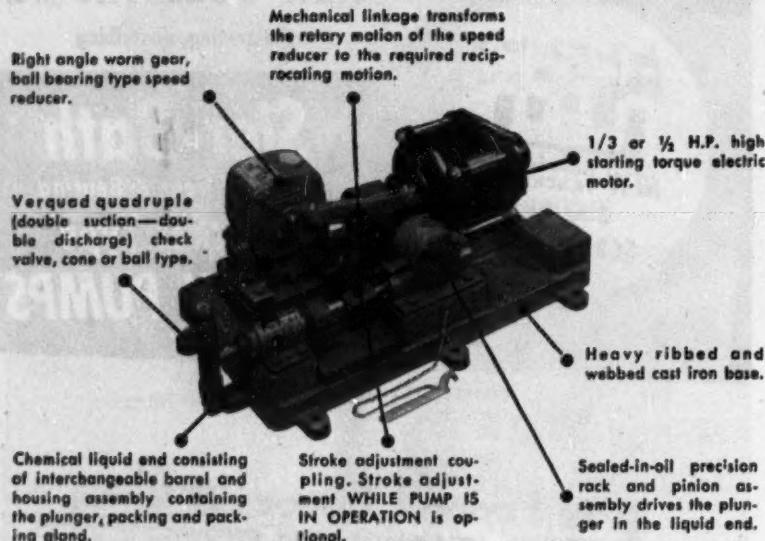
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### PRO & CON, cont. . .

such estimates is not great it is frequently sufficient to eliminate projects from further consideration or to show that they possess extremely attractive profit potentials. This is most important in conserving research and development manpower and in increasing the effectiveness of industrial research.

Mr. Wessel is to be congratulated for his paper. I hope that he will make further contributions to the literature in this field.

**JAMES H. BOYD**  
Consulting Chemical Engineer  
New York 17, N. Y.

### Speeds and Mixer Costs

Sir:

I think the Lewis article "Your Guide to Mixer Costs" in your January issue is a very worthwhile discussion and should serve a useful purpose to your readers.

Most of the data had to do with heavy-duty mixers handling very viscous materials. My particular interest is in the mixing of liquids and less viscous materials and I have a few comments on costs for propeller and turbine mixers.

I think that the data in Table 3 showing horsepower and working capacity are excessively high for average mixing. I realize, however, that it is difficult to state a power requirement in terms of working capacity without regard to the chemical or physical process involved.

Data in the curves showing installed costs for propellers and turbine mixers are inadequate and may be misleading, for the speed and size of a mixer impeller are important factors not only in process results but also in the cost of the mixer.

I have compared, for example, list prices of two propeller mixers each rated at 7.5 hp. being run at different speeds. The ratio of cost for the one running at 420 rpm. to one running at 20 rpm. is 1 to 2.7. This ratio was for steel equipment complete with motor, drive, shaft and propeller. It is well known that there may be a tremendous difference in the process effect between applying 7.5 hp. with a propeller turning at 420 rpm. and a large propeller turning at 20 rpm. at the same power.

Since impeller speed is so important I think that you could follow up this article to explain that mixer costs

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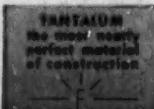
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### PRO & CON, cont. . .

can only be estimated accurately as a function of speed. Note in this example the very wide range of prices for the same power mixers.

J. H. RUSHTON

Director

Dept. of Chemical Engineering  
Illinois Institute of Technology  
Chicago, Ill.

► Dr. Rushton, well-known authority in the field of liquid mixing, passes along a worthwhile suggestion for an article explaining how mixer costs can be estimated as a function of speed. We're following up the idea.—ED.

### How to Write A Letter

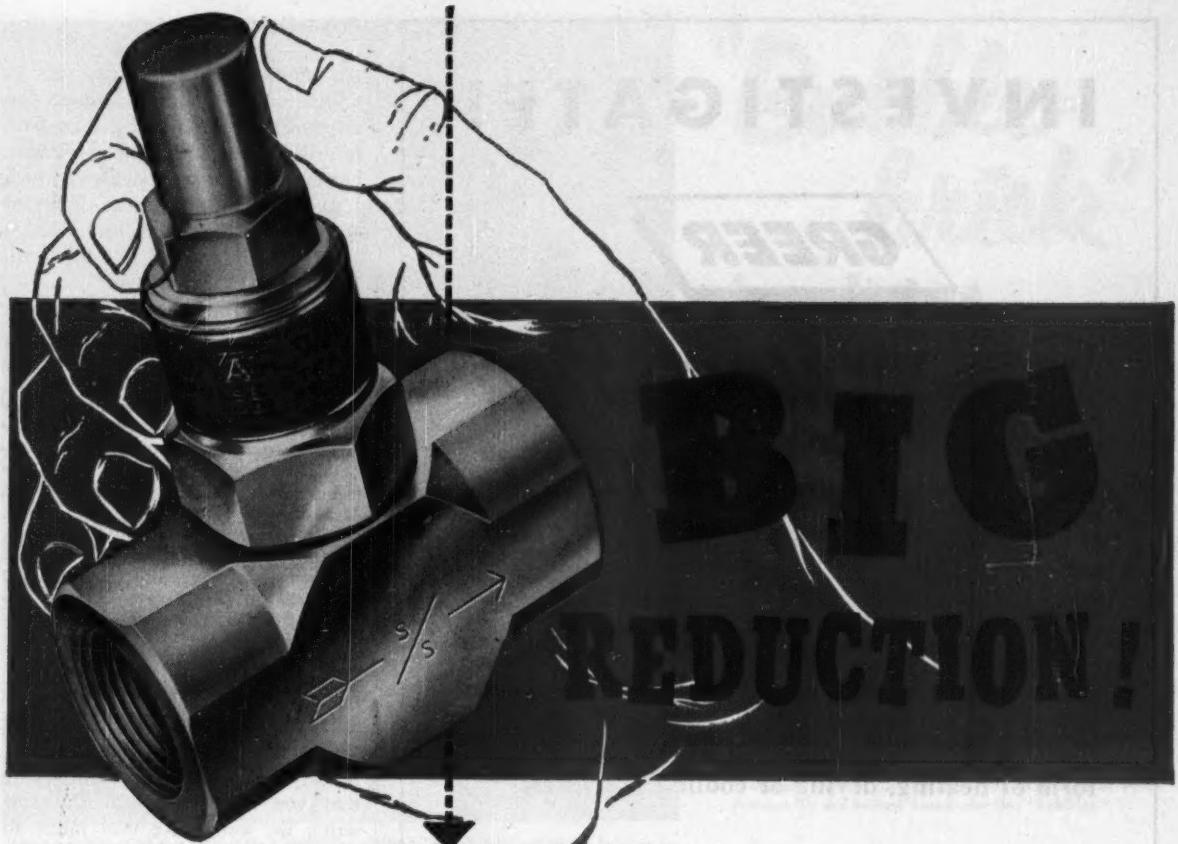
Sir:

I would like to make a comment or two on "How to Write Poor Letters" on p. 246 in your January issue.

I am in thorough agreement that, in general, short phrases, terse expressions, and so on are desirable. However, one very strong principle of sales correspondence is to take into account the personality of the recipient of the letter. If the recipient thinks in "Victorian" phrases, then it is a good idea to address him that way. He may not feel comfortable with terse, condensed phrasing. Of course there are only two ways to judge this, one of which is by personal acquaintance with the recipient, and the other is by the way he writes. The latter, however, may be a good indication of how he thinks, and if his letters are of the "poor" variety, it may be a good idea to reply to them in the same way.

I would especially decry the idea that informality is a desirable feature in business correspondence. Informality has its place, but most business correspondence can be better kept on a rather impersonal, formal basis. After all, formalities make it possible for us to get along with strangers, or even with people we know but do not like. Formality might be said to be the lubricant of social intercourse. There is quite a bit to be said for the military type of correspondence. When personalities get into correspondence, there is apt to be quite a bit of chance of friction, since such "informality" may often lead to ribbing that is not well received, since the ribber may not feel in the same jocose mood as the ribbed, at the time he receives the letter.

The foregoing probably falls well within the definition of a "poor" let-



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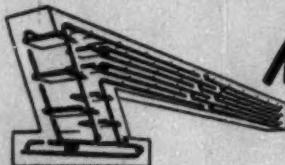
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PRO & CON, cont. .

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ter, but I do want to put in a plea for a little more formality in business correspondence. I can and do use both formal and informal types of letters, but I am rather particular about which I use, depending upon my degree of acquaintanceship with the recipient.

J. B. McMAHON  
Republic Flow Meters Co.  
Chicago 47, Ill.

► While we can see Reader McMahon's point on formality in business letters, we cannot agree. Most people, we believe, write Victorian prose not because they prefer it but because it's what they were taught.

What we advocate is more informality in business letters. But we do join Reader McMahon in heartily condemning rudeness and familiarity under the guise of informality.

If you slap a strange lady on the back at a cocktail party, that's familiarity; if you admire her hat, that's informality.—ED.

#### Another Cost Challenge

Sir:

Congratulations on your excellent January issue. We are pleased to note that you have started a new cost series; we would like very much to have you include a discussion on the cost of chemical process piping, since this is an important factor in chemical plant construction costs.

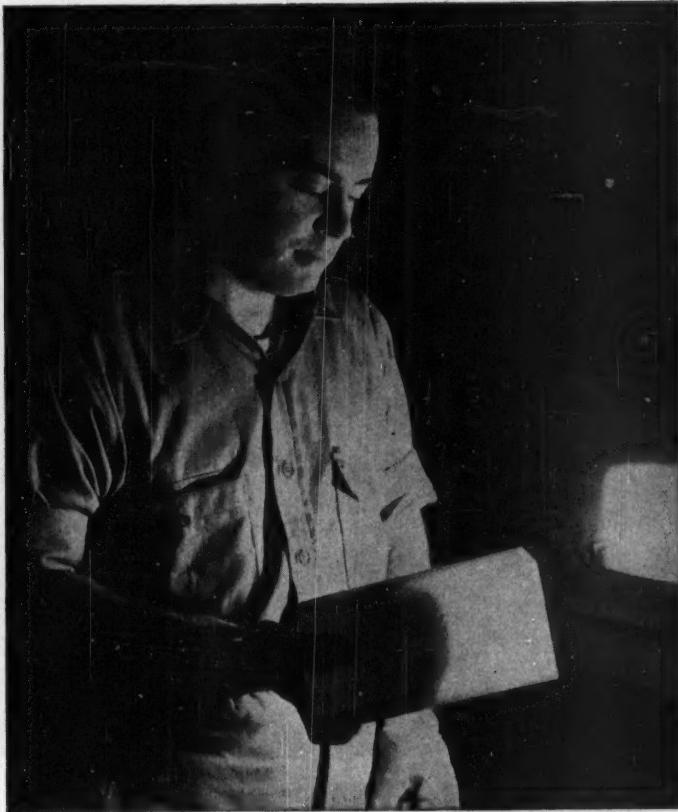
We are also pleased to note that George E. Lewis' article — "Your Guide to Mixer Costs"—gave the Engineering News-Record cost index value for the period during which the cost data were accumulated. It would be helpful in cost analyses for all writers to correlate their costs with such indexes as the Engineering News-Record index or the Marshall & Stevens index which you publish in Chemical Engineering.

In view of the conflicting published information on maintenance costs, we recommended that you consider publishing an article on maintenance cost of different types of chemical plants.

J. J. BOHNLOFINK  
Chief Engineer  
U. S. Industrial Chemicals Co. Div.  
National Distillers Products Corp.  
Baltimore, Md.

► Reader Bohnfink challenges us to publish a comprehensive article on maintenance costs of different types of chemical plants. That's a tough challenge, and one that we're first throwing out to all our readers. What are your ideas and suggestions?—ED.

—End



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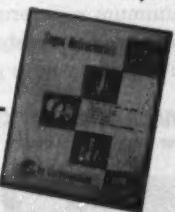
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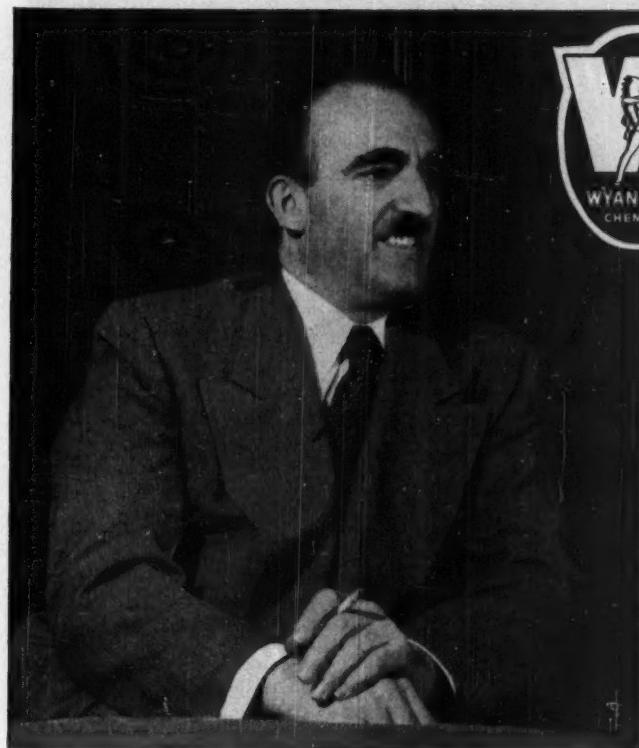
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Abrasive Wheels

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings  
Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls

You can't stop a bear with a fly swatter



You can't stop corrosion with ordinary paints...  
it takes **BITUMASTIC COATINGS!**

**CORROSION** can't be stopped by ordinary paints or conventional protective coatings. They can't protect surfaces against the ravages of rust for any appreciable length of time. But Bitumastic Coatings can!

**BECAUSE** the six Bitumastic® Protective Coatings, unlike maintenance paints, are specially formulated from a coal-tar pitch base\* that is, for all practical purposes, impervious to water. When you keep moisture away from an exposed surface, you *stop* corrosion.

**BECAUSE** Bitumastic Coatings provide an extra-tough, extra-thick barrier against corrosive elements—a barrier that is impenetrable. These coatings provide up to 8 times the film thickness of conventional paint coatings.

**BECAUSE** Bitumastic Coatings stop

corrosion caused by moisture—acid fumes—alkaline fumes—salt air—heat.

*There are 6 Koppers Coatings—formulated to control corrosion of metal and deterioration of concrete. Use the coupon for full information, or see our catalog in Sweet's Plant Engineering File.*

\*Hi-Heat Gray contains a metallic base.

SEND FOR SET OF FREE BOOKLETS!

Koppers Company, Inc., Tar Products Division  
Dept. 459-T, Pittsburgh 19, Pa.

Please send me, without charge or obligation, complete information on corrosion prevention.

Name.....

Address.....

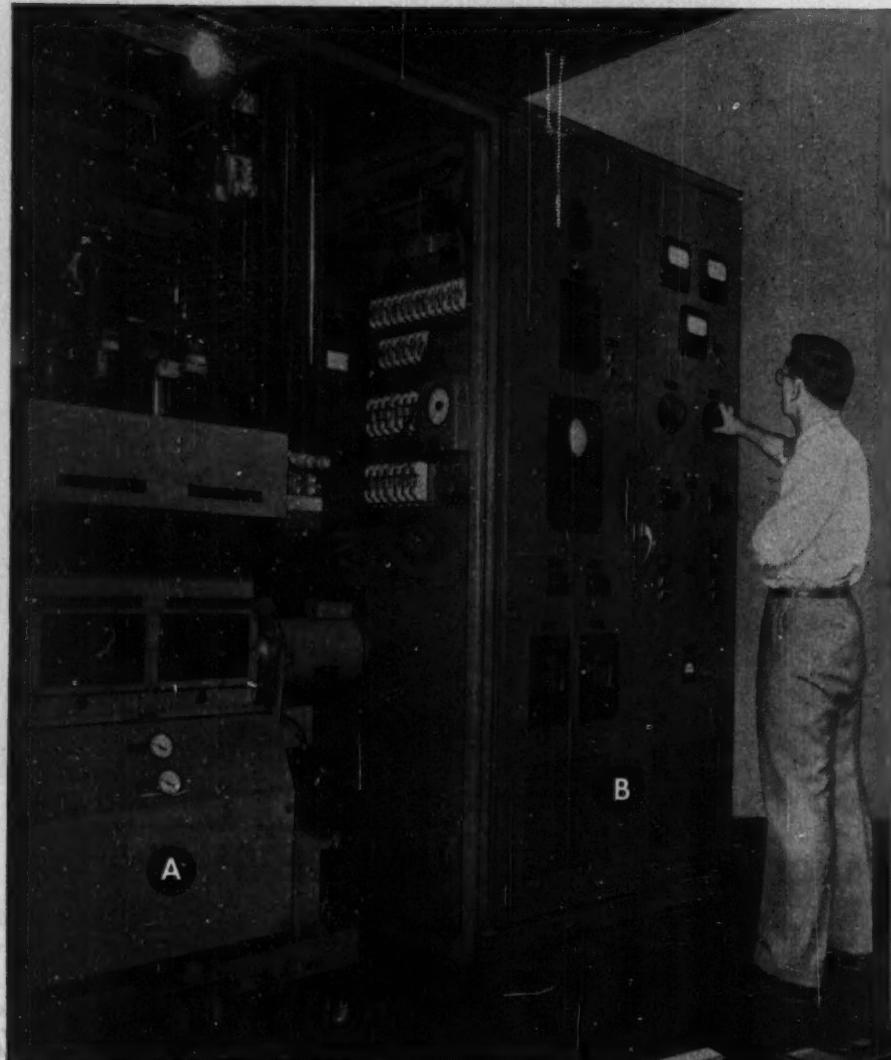
City..... Zone..... State.....



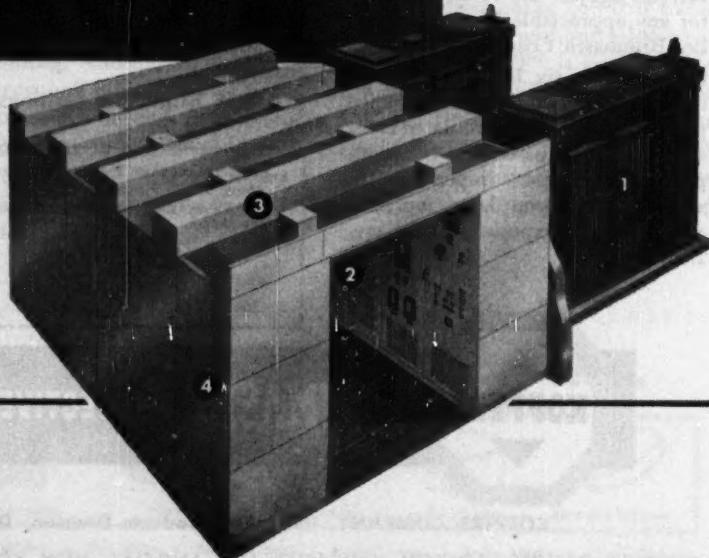
KOPPERS COMPANY, INC., Tar Products Division, Dept. 459-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

# Heavy d-c current...low d-c voltage



10,000 ampere I.T.E. Mechanical Rectifier supplying d-c to electrolytic chlorine cell line. Note how neatly and compactly the contact mechanism (A) and control panel (B) are arranged.



A complete I.T.E. Mechanical Rectifier installation includes: transformer and commutating reactor (1), contact mechanism (2), overhead bus (3), and d-c switchgear (4). No additional auxiliary equipment is necessary.

# .....with highest efficiency!

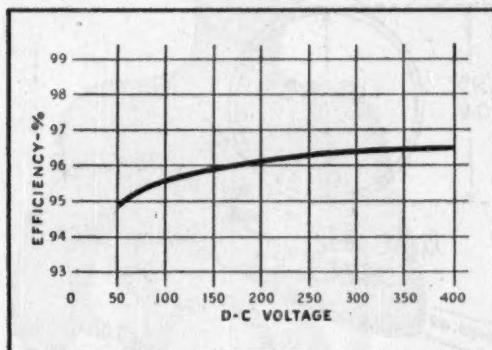


FIG. 1

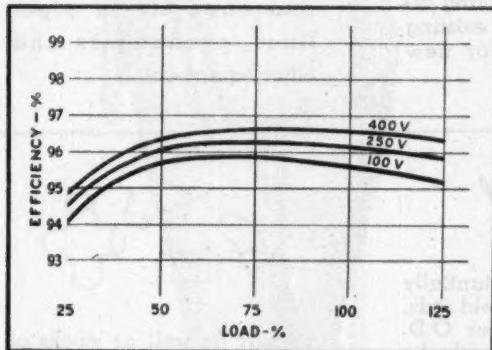


FIG. 2

#### Send for details

Bulletin 5205 explains how, from a-c line to d-c bus, the I-T-E Mechanical Rectifier gives you efficiency of 96%—and higher. Send for a copy today.

5,000-10,000 d-c amperes—or multiples thereof—available between 50 and 400 volts, with an over-all efficiency of 94%-96%

Chief advantage of the I-T-E Mechanical Rectifier is its consistently high efficiency in the 50-400 volt range. Note (Fig. 1) how high the efficiency is even when operating voltage is as low as 50 v.

Note (Fig. 2) how high efficiency is maintained even at 25% of rated load current.

High efficiency of the I-T-E Mechanical Rectifier is substantiated by thirty-seven units in service—more than 200,000 amperes of connected load.

#### ADVANTAGES OF LOWER VOLTAGES

Lower operating voltages are less hazardous. Leakage losses to ground, the plague of electrolytic cell lines, are substantially less when operating voltage is under 400 volts d-c. Greater flexibility can be designed into systems. Large or small quantities of electrolytic products can be manufactured economically.

#### SUBSTANTIAL SAVINGS

High efficiency means big savings. Assume a 10,000 kw load, a power rate of  $\frac{1}{4}$  cent per kwhr, and continuous operation at 250 volts d-c. Then, for each 1% improvement in over-all efficiency, yearly savings amount to \$3200 or more.

#### OTHER BENEFITS

The compact I-T-E Mechanical Rectifier saves space. It requires no special buildings, foundations, cooling or ventilation.

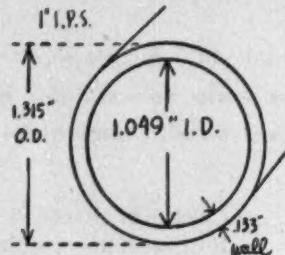


## MECHANICAL RECTIFIERS

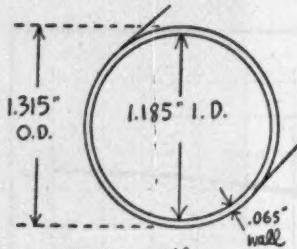
I-T-E CIRCUIT BREAKER CO. • Rectifier Division • 19th and Hamilton Sts. • Phila. 30, Pa.

EPD—Canadian Mfg. and Sales: Eastern Power Devices, Ltd., Toronto

# here's what you gain with stainless schedule 5 pipe



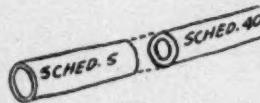
heavy wall  
schedule 40



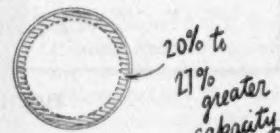
light wall  
schedule 5



You save  
money. Schedule 5  
pipe costs about half as much  
per foot as Schedule 40.



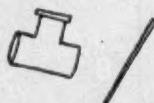
Schedule 5 has the same O.D.  
as Schedules 10, 40 and 80  
—for hook-up with existing  
lines as well as for new  
installations.



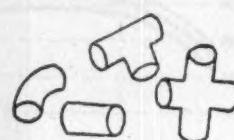
Its larger I.D. increases flow  
and capacity in pipe-  
lines, exchangers and  
other equipment.



It's lighter.  
This means  
quicker and easier  
installation.



You can save substantially  
on valves, fittings, weld rods,  
etc., because smaller O.D.  
material can frequently be  
used. Tubing sizes can now  
be replaced with light wall  
pipe . . . for ready hook-up  
with standard valves, pumps,  
and other equipment  
normally manufactured in  
pipe sizes.



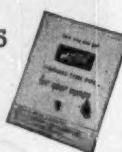
Fittings as well as stocks of  
Schedule 5 pipe are carried  
by conveniently located  
Carpenter distributors.

**Specify Schedule 5 pipe . . . it saves dollars . . . and makes a lot of sense!**

**THE CARPENTER STEEL COMPANY**  
Alloy Tube Division, Union, N. J.

Export Dept : The Carpenter Steel Co., Port Washington, N.Y. "CARSTEELCO"

*Data Sheets* give you complete  
information about Carpenter Schedule 5  
Stainless Pipe. Write for your  
personal copy.



# Carpenter

**STAINLESS TUBING & PIPE**



A

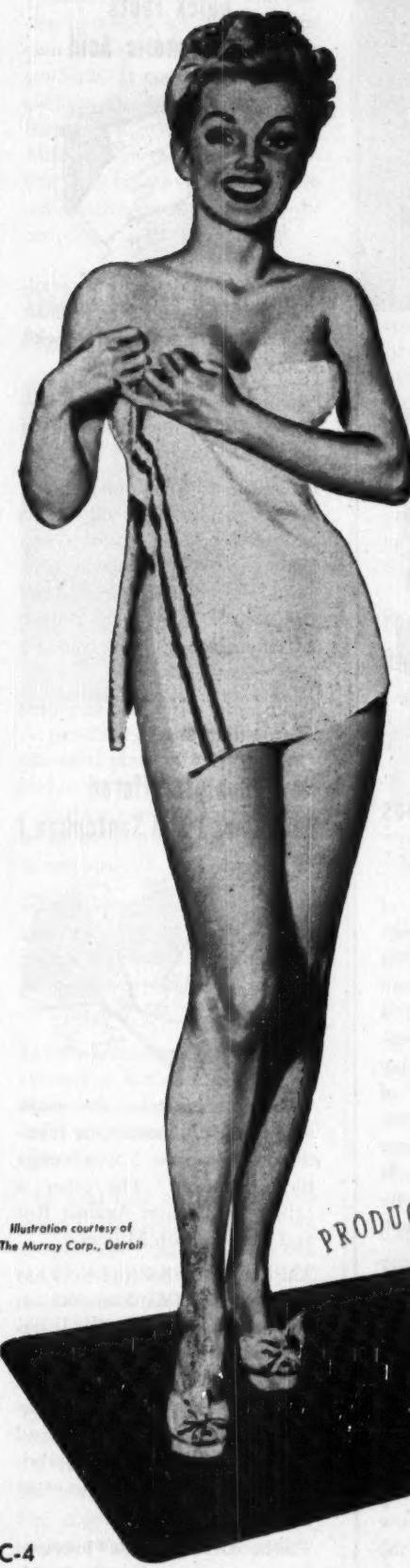


T

F

- guaranteed on every shipment

April 1953—CHEMICAL ENGINEERING



# If you're looking at the bath mat...

then you'll realize that NEVILLE plays an important part in the production of many household items, whether it's a bath-mat, stair-treads, drain-mats, floor-tile or molded electric plugs, as well as enamels, paints or varnishes. In countless every-day products, quality and durability are assured when the manufacturer uses

**NEVILLE**

**COUMARONE RESINS**

PRODUCTS OF TOMORROW FROM THE CHEMICALS OF TODAY

Illustration courtesy of  
The Murray Corp., Detroit

*Tell us your particular need—we'll help you select  
the right Neville chemical for your purpose.*

**THE NEVILLE COMPANY**

PITTSBURGH 25, PA.

Plants at Neville Island, Pa., and Anaheim, Cal.

C-4

# for your information...

brief summaries of helpful product news



## Actamer, New Nonirritating Bacteriostat for Soaps, Shampoos And Shaving Creams, Kills 97% of Odor-Inducing Bacteria

A powerful new bacteriostat that combines several important advantages was described in recent New York meetings of the Chemical Specialties Manufacturers Association, and the Toilet Goods Association.

Small quantities of the bacteriostat, known as Actamer, will be particularly useful in controlling body odors, and may aid in controlling minor skin disorders and complexion problems, according to reports given at the two meetings.

Actamer combines unusual antimicrobial activity with low toxicity and the ability to cling to the skin. Actamer has been shown applicable in deodorant and pre-surgical scrub soaps, and is reported to show real promise for use in shampoos, lotions, shaving creams and other cosmetics.

In the papers given at the New

York Meetings, the results of extensive hand-washing tests carried out by the Monsanto and by independent laboratories were reported. The tests showed a 97.4 per cent reduction in resident skin bacteria over a 12-day period. The "staying power" of the ingredient also was demonstrated by discontinuing the use of soap containing Actamer. It required over a week for the bacteria count to return to normal.

Reported results of oral toxicity tests indicated a low order of toxicity in rats and rabbits.

Irritation and sensitization were also investigated. Standard patch-test techniques were used on a large number of human subjects. No reactions attributable to Actamer were detected.

For price quotations on this new Monsanto development, clip the coupon and mail it today.

## Quick Facts On Phosphoric Acid



Orthophosphoric acid is available from Monsanto as a clear, water-white liquid, miscible with water in all proportions.

Monsanto supplies both 75% and 85%  $H_3PO_4$  as part of a standard line of products.

Monsanto 85% phosphoric acid is N.F. and the 75% fully meets all Pure Food Law requirements. You can obtain it in special 650-pound tight oak barrels; 55- and 15-gallon stainless steel drums; 13-gallon carboys; tank cars and tank trucks.

Write us for price and shipment information, today.

## New Booklets Offered On Milmer 1 and Santophen 1



Two new booklets are now available from Monsanto. One is entitled "Santophen 1... a Versatile Germicide." The other is called "Protection Against Rot and Mildew with Milmer 1."

The booklet on Santophen\*1 has 16 pages of useful information on this important germicide. It describes the physical and chemical properties of Santophen 1 in both solution and solid form. It discusses in a concise, easy-to-read way the applications of this product in soaps and numerous other products.

The booklet on Milmer\*1 reviews the many ways in which this

product can control rot and mildew in textiles, vinyl plastic film, coated fabrics, cordage and other products. It contains interesting performance figures on numerous tests showing the effectiveness of Milmer 1 in these applications. For your copy of either of these informative booklets, mail the coupon.

### Special Service Delivers Plasticizer Order in One Day



A purchasing agent of a large chemical plant in an emergency had to get forty drums of dibutyl phthalate and get them within hours. What did he do? He called Monsanto.

Here's what happened. Monsanto received the order at three o'clock on a Friday afternoon. Soon wires were buzzing in production and shipping.

In only a matter of hours, on the evening of *that same day* a Monsanto truck had delivered the order to the customer nearly 400 miles away.

The next day a wire from this customer arrived in Monsanto sales offices: "NEVER BEFORE HAVE I SEEN SUCH SERVICE AS ON THE TRUCKLOAD OF DIBUTYL PHTHALATE YOU SHIPPED...ON FRIDAY...SHIP ANOTHER TRUCKLOAD . . ."

This case, of course, was a special emergency. But it does indicate the type and degree of service that is a specialty with Monsanto. For more information on fast shipments of plasticizers, send in the coupon.

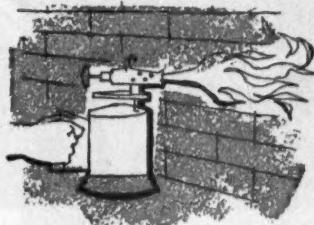
### Fast-Growing Interest Shown in Liquid Fertilizers

There's a new market that's opening up more every day... soluble fertilizers.

Formulators find liquid fertilizers sell because they have several advantages for users. They are easy to apply, clean to handle... just add water. They are efficient to use... nutrient benefits readily available to the plant. And they are versatile... can be used for leaf feeding, starter solutions and many other applications.

For information on how Monsanto ammonium and potassium phosphates and phosphoric acid can help in *your* liquid-fertilizer formulation, use the coupon.

### Bonding Agents Make Good Record at High Temperatures



With the increasing swing to high-temperature furnace operations in a wide variety of industries, the need for effective bonding agents has multiplied rapidly.

To meet this challenge, Monsanto has developed a variety of liquid and solid aluminum acid phosphates which are highly effective bonding agents for refractories.

Called Alkophos, this family of

- MONSANTO CHEMICAL COMPANY  
1703 South Second Street, St. Louis 4, Missouri
  - Please send:
    - Actame. quotations
    - Sterox 6 booklet
    - Milmer 1 booklet
    - Santophen 1 booklet
  - Name.....
  - Company.....
  - Street.....
  - City..... Zone..... State.....
- 3/3
- \*Reg. U. S.  
Pat. Off.  
Actame:  
Trade-mark

**MONSANTO**  
CHEMICALS - PLASTICS

SELLING INDUSTRIES... UNDER SEPARATE AGREEMENT

Dibutyl Phthalate information  
 Phosphoric Acid bulletin  
 Quotation on ammonium and potassium phosphates  
 Quotation on Alkophos

compounds is used in high temperature cements and refractory paints. These phosphates impart a high green strength which makes possible molded shapes, set in place without firing and fired in place to yield high temperature nonslagging refractories.

In certain quick-setting applications, they are quite effective when used with a proportion of asbestos or talc. These products are not recommended for use in the presence of most alkaline materials.

For more information on Alkophos, check the coupon.

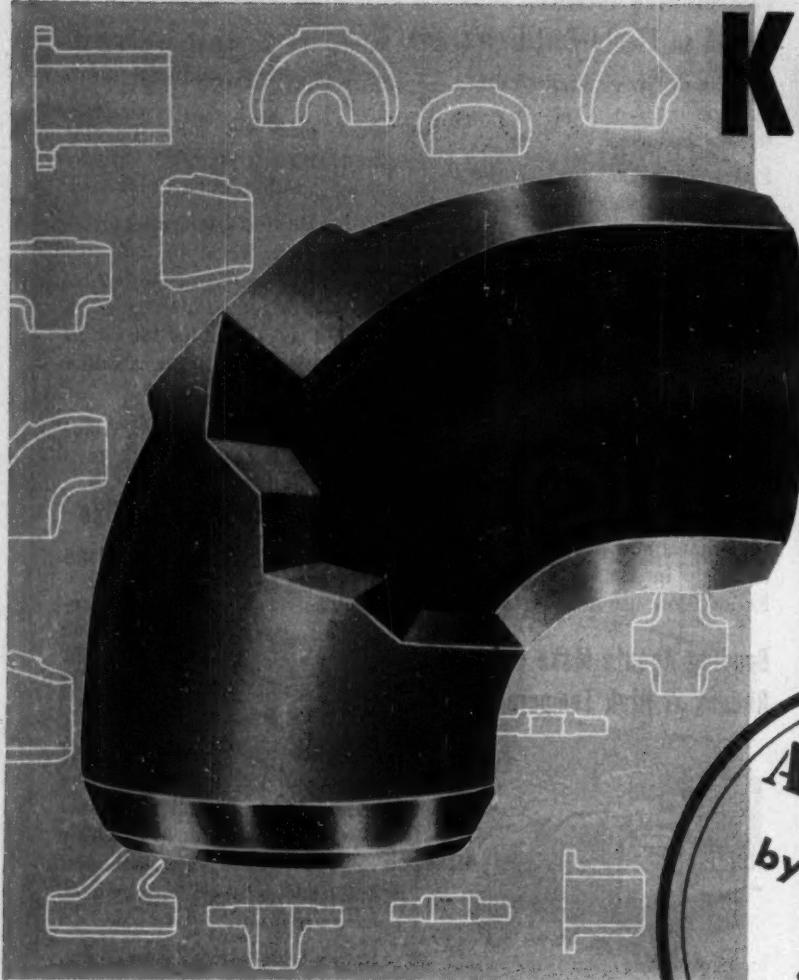
### Sterox 6 Excellent for Use In Wool Scouring Operation

A clear, straw-colored, surface-active agent of the nonionic type is now proving itself exceptionally valuable for wool scouring in the textile field.

Called Sterox\* 6, this compound speeds up oil, grease and dirt removal. Actual mill tests show that it produces a cleaner, fluffier wool. Moreover, less detergent and soda ash are required, so costs are lower.

Sterox 6 gives easier rinsing, can be mixed quickly. It is compatible with phosphate, carbonate and silicate builders. Liquid form makes accurate proportioning easy, and high concentration means economy in use.

To increase the effectiveness of *your* wool-scouring operation, find out more details on Sterox 6 by sending the coupon.



# KEY-KAST

alloy steel

welding fittings

and flanges

APPROVED

by leading

- refineries
- power plants
- chemical plants

**2 REASONS why Key-Kast fittings  
can be the strongest part of YOUR  
piping system—too!**

- 1 Engineered for longer life! Greater wall thickness throughout . . . for increased structural strength—plus greater allowance against corrosion and erosion.
- 2 Complete quality control. From the metallurgical laboratory through the latest testing facilities to the final inspection . . . Key-Kast products must pass the most rigid requirements—your assurance of maximum dependability.

Key-Kast Fittings and Flanges are available for prompt delivery in many shapes . . . sizes . . . and schedules . . . in low and intermediate alloys and various stainless steels . . . and at low unit costs.

Write for brochure and complete information...today!

Since 1916... manufacturers and developers of  
products for high temperatures and pressures

DISTRICT OFFICES: NEW YORK • CLEVELAND  
CHICAGO • TULSA • HOUSTON • LOS ANGELES

key company

# News about flexible metal hose and tubing

These are 3 jobs that design, production and maintenance engineers have given them to do

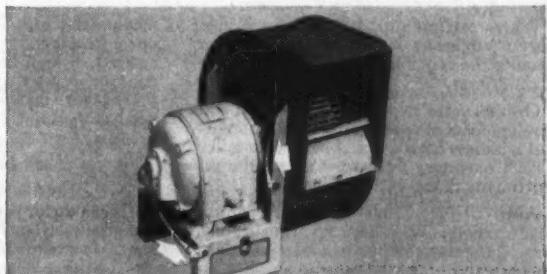


**REMOVES DANGEROUS FUMES** — Here, American Flexible Metal Hose helps meet production schedules and lessens costs by making working conditions safer on assembly lines. It carries away heat and gases from brazing



**DAMPENS VIBRATION AND NOISE**—which ordinarily would be carried along piping from compressor to air-cooled working areas in the Mission State Bank, Kansas City, Kansas. Two American Vibration Eliminators— $3\frac{1}{2}$  in. I.D. on the liquid side and 4 in. I.D. on the gas side—absorb compressor vibration. Since they also provide for expansion, there is little danger of cracked lines. Air conditioning unit installed by Betz Engineering Co., Kansas City, Mo.

operation. This hose installs and positions easily. If you need a connector that must move, bend or convey liquids, steam, semisolids or gases, American can give you a flexible metal hose or tubing of the right alloy for your specific job.

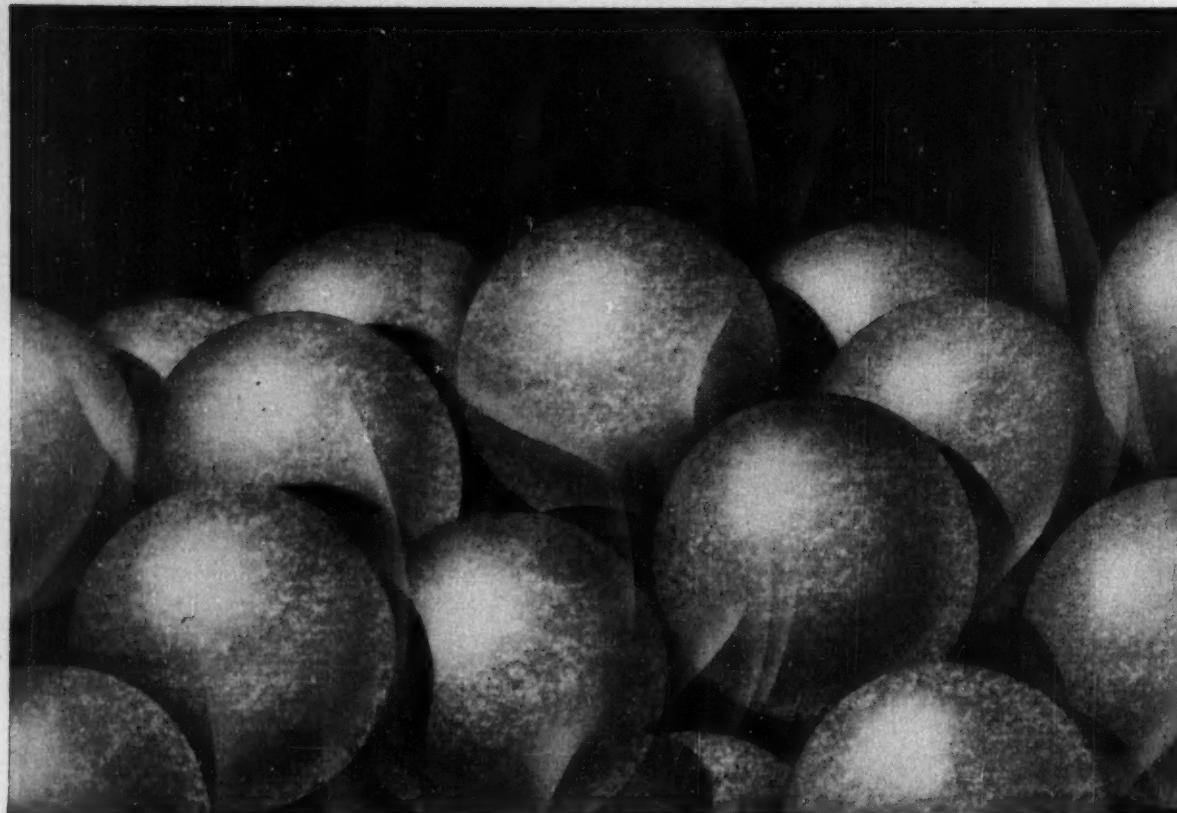


**MAKES LUBRICATION POSSIBLE**—This blower, manufactured by Master Fan Corporation, Los Angeles, is incorporated into the air conditioning equipment of a very compact electronic unit, and may be serviced only through a small inspection opening. Out-of-reach motor bearings are greased and flushed through three lengths of American Flexible Metal Tubing. The blower is built to AN specifications.

**WRITE FOR BOOKLET SS-50:** shows how the tubing is designed, used and installed—gives specifications on tubing and fittings. The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Co., Ltd.

wherever connectors must move...

**American** flexible metal hose and tubing



Spheres "Bed" Perfectly in catalytic processing. In Norton Spherical Catalyst Supports you get uniform beds that promote uniform flow of

gases and assure minimum pressure drop. Spheres are available in sizes  $3/16''$  to  $1''$ . Supports in Ring and Pellet form in sizes  $\frac{1}{8}''$  to  $2''$ .

## Catalyst supports to your special prescription

*... Norton engineered for your special requirements*

Where catalyst supports were applicable Norton engineers have been successful in meeting the requirements of a large variety of conditions.

Over 40 years' experience in research and developments of special refractory materials and mixtures have enabled Norton to tailor special refractory mixtures to meet the requirements of the chemical industry.

ALUNDUM<sup>\*</sup> Catalyst Supports are a good example. They have such qualities as great refractoriness, chemical inertness, strength and high resistance to abrasive action. They are made by Norton's exclusive "controlled structure" process. It provides

medium porosity of 30-35% with rough open structure for maximum adherence of catalyst, or high porosity 42-47% with large connected internal pores, uniformly dispersed for maximum deposition of the catalyst.

### *Test them yourself*

See what Norton ALUNDUM Catalyst supports can do for you. If you would like to see samples, see your Norton refractories representative or write Norton Company, 508 New Bond Street, Worcester 6, Mass. Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

\*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

**NORTON**

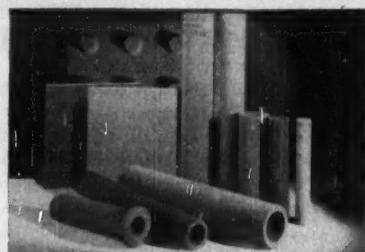
## *Special REFRactories*

*Making better products to make other products better*

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS



Norton Exclusive Fused Stabilized Zirconia, an amazing material able to take temperatures double the melting point of most metals. No other refractory is so chemically stable at such high temperatures. (Up to 4700°F.) Ask for Bulletin 793.



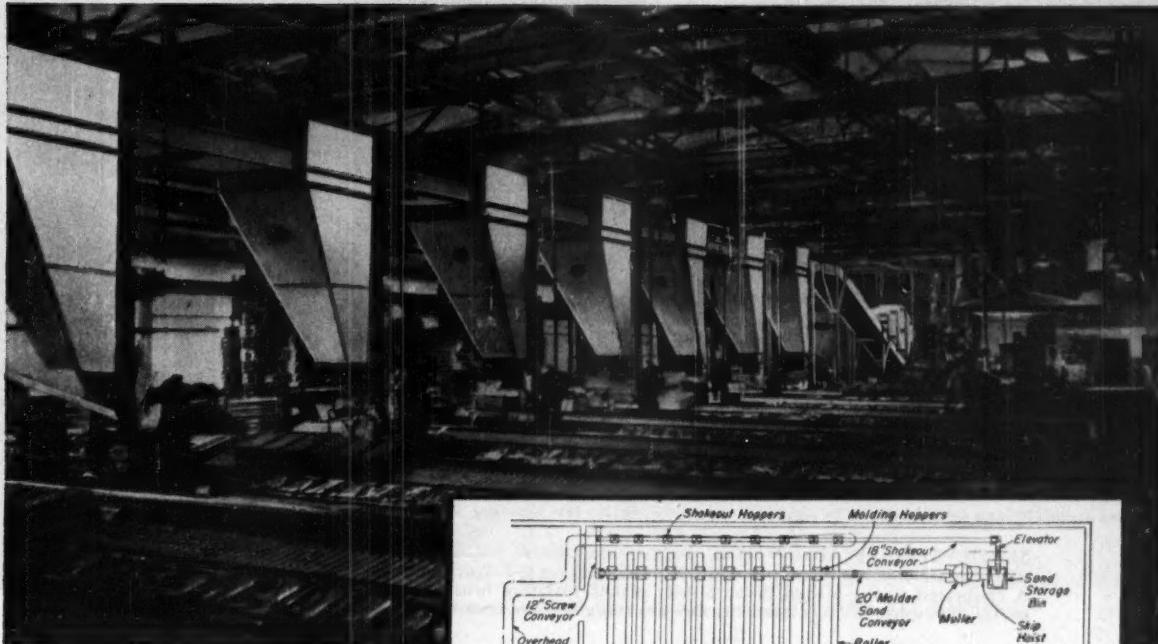
Norton Exclusive. Norton ALUNDUM Seamless Tubes for filtration, aeration, diffusion maintain constant air or liquid pressure. ALUNDUM porous mediums also available in plates, discs and diaphragms. Ask for Bulletin No. 140.



**engineered materials handling**

## 8 WAYS BETTER

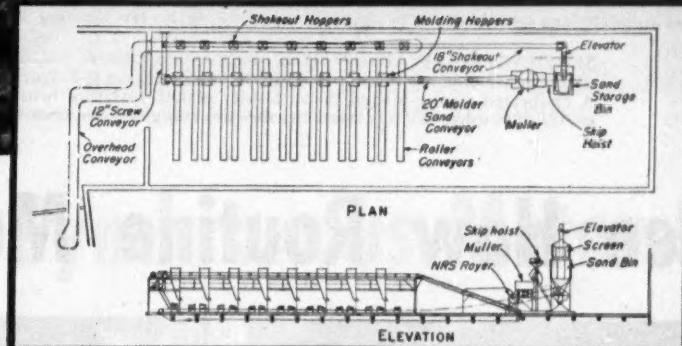
FOR CHASE BRASS & COPPER CO., INCORPORATED



In the foundry operation of Waterbury Manufacturing Co. — a division of Chase Brass & Copper Co., Incorporated — Gifford-Wood has engineered eight major improvements in the handling of molding sand, molds, and castings into the new materials handling system. These improvements, brought about by the G-W system include —

1. Consolidation of two foundry rooms into one.
2. Higher production through more efficient space use.
3. One casting method replaces two formerly used.
4. Virtually all manual handling has been eliminated.
5. Casting quality has been increased.
6. Working conditions are considerably better.
7. Maintenance costs have been reduced.
8. Over-all production time has been cut sharply.

This is but one of the more recent materials handling problems solved by Gifford-Wood. For more than 140 years, G-W has designed, built, and installed similar complete systems for nearly every industry in the book. This experience is at your disposal.



A 20"-wide overhead conveyor moves molding sand past molding hoppers where operators remove it as needed by a lever-operated diverting plate. A 12" screw conveyor transfers unused sand laterally to an 18" shakeout conveyor at which point used sand collected from the molders in shakeout hoppers is added. A bucket elevator then dumps it into a storage bin from which it is skip-hoisted to a muller for mixing with new sand. After sintering and cooling it is deposited on the original belt for re-use. Roller conveyors handle molds at molding stations, and castings move to finishing on overhead monorail conveyors.

For details on this and many other G-W installations, ask for Materials Handling Catalog.

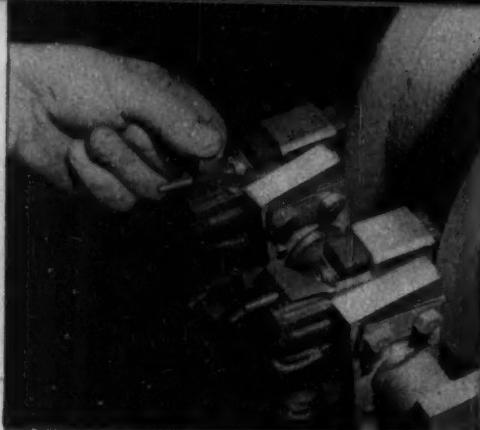
*When You Think of Materials Handling—Think of GIFFORD-WOOD*

**GIFFORD-WOOD CO.**

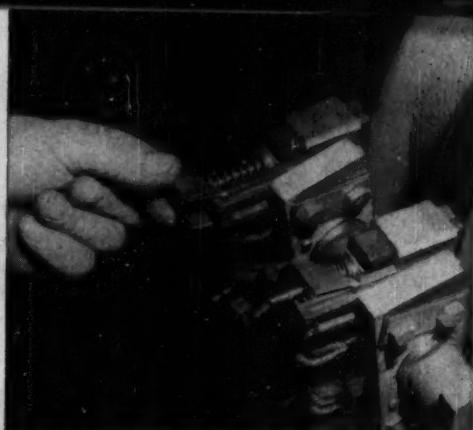
Since 1814 • Hudson, New York

NEW YORK 17, N.Y.  
420 Lexington Ave.

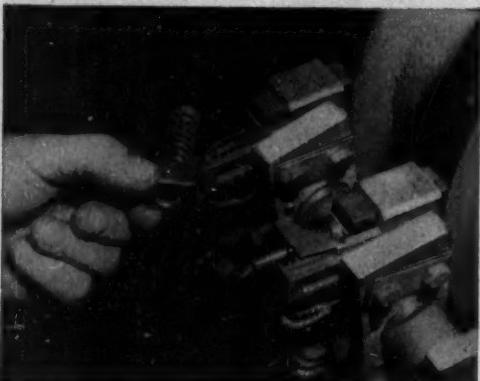
ST. LOUIS 1, MO.  
RAILWAY EXCHANGE BLDG. 565 W. WASHINGTON ST.



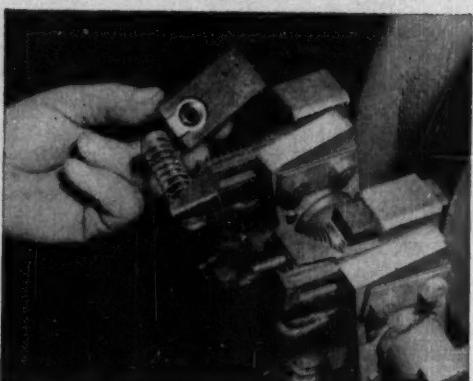
1 To reset brush tension, operator releases spring lock . . .



2 . . . slides it back to relieve pressure . . .



3 . . . and swings locking device to one side . . .



4 . . . for fast and easy brush removal.

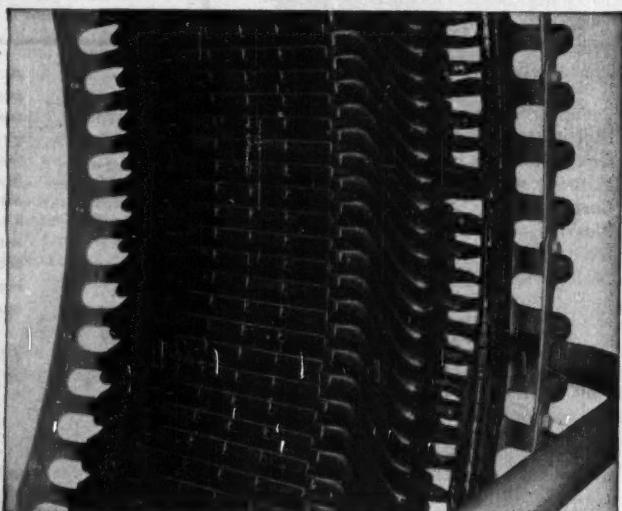
**BRUSH-PRESSURE ADJUSTMENT**, for maximum brush life, and replacement, to assure reliable motor service, are simple matters on G-E synchronous motors. A calibrated spring-loaded brush holder makes resetting brush tension or removal of brushes fast and easy. Brushes are staggered for even brush-ring wear.



## See How Routine Maintenance Is

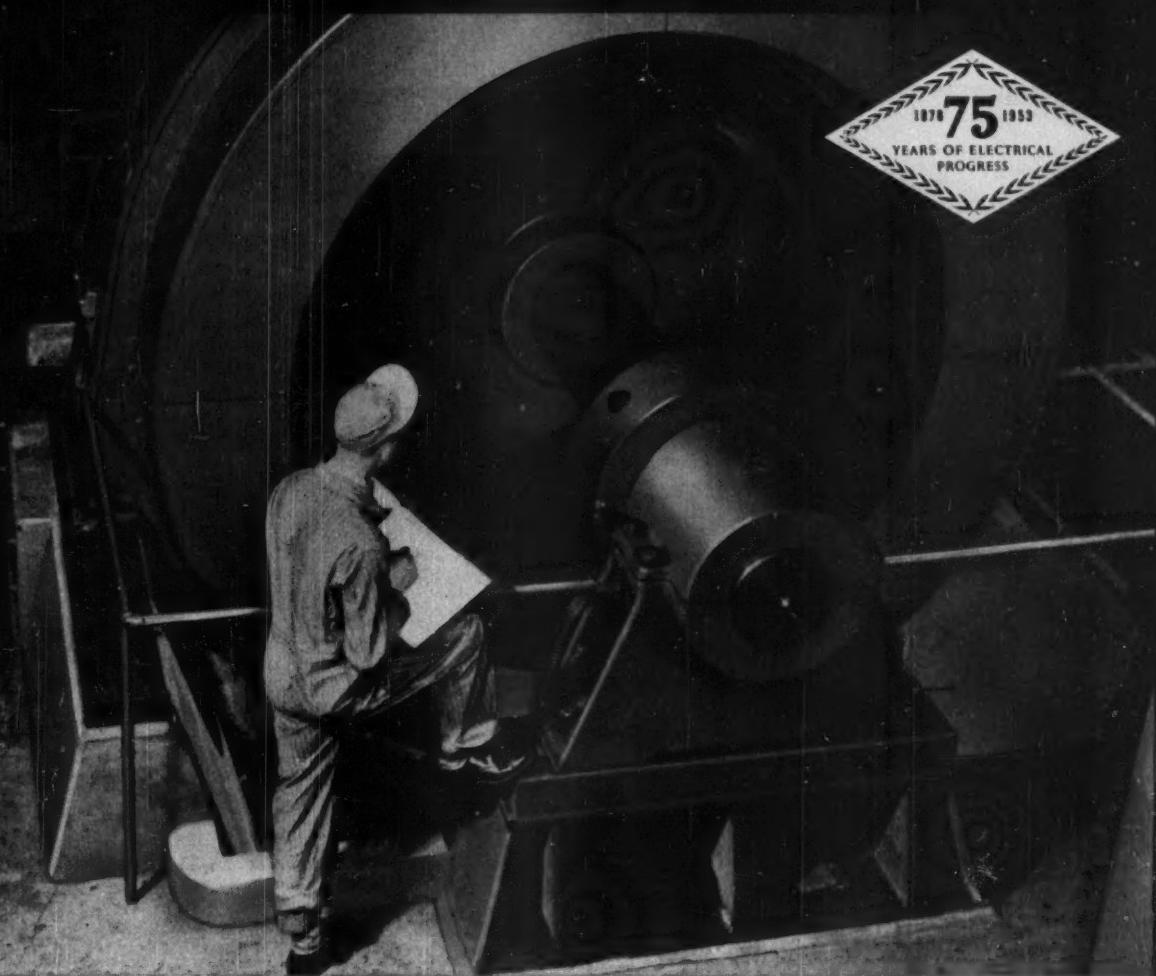


**BEARING LUBRICATION** can be readily checked through a large sight-level gage on the bearing pedestal; and when oil is required, handy snap-top covers are provided for easy refilling, as well as oil-ring inspection. A drain plug is conveniently located for quick oil changes.



**INSULATION CLEANING** is fast on G-E synchronous motors. Windings are coated with a high-gloss Glyptal\* varnish that resists the accumulation of dust and can be vacuum or air cleaned in most applications. In extremely dusty or oily atmospheres, deposits can be easily wiped from the windings. Clean windings mean longer insulation and machine life.

\*Reg. trademark of General Electric Co.



THIS G-E SYNCHRONOUS MOTOR, RATED 4500 HP, 300 RPM, DRIVES A RECIPROCATING GAS COMPRESSOR.

## Easier on G-E Synchronous Motors!

Routine maintenance involves three factors: brushes, lubrication, and insulation. To be sure that these areas are properly serviced, G-E synchronous motors have design features that make checking easy and maintenance fast. Close at hand and easy to adjust, the brush-rigging construction encourages your maintenance men to inspect regularly. Oil-level gage and inspection caps are arranged for quick checking and filling when necessary. The high-gloss insulation on G-E synchronous motor windings resists the adhesion of dust and minimizes the need for cleaning.

These features promote long, reliable motor

service and save valuable time for your maintenance crews.

**Before selecting your next heavy-duty motor,** be sure to consider these important maintenance features. Call in your G-E representative. He will be glad to discuss the many money-saving applications for G-E synchronous motors. Meanwhile, you can obtain more information on G-E synchronous motors by requesting the following publications: GEA-5332, "Low-speed Synchronous Motors" or GEA-5426, "High-speed Synchronous Motors." Write to Section 770-28, General Electric Company, Schenectady 5, N. Y.

*You can put your confidence in—*

**GENERAL**  **ELECTRIC**

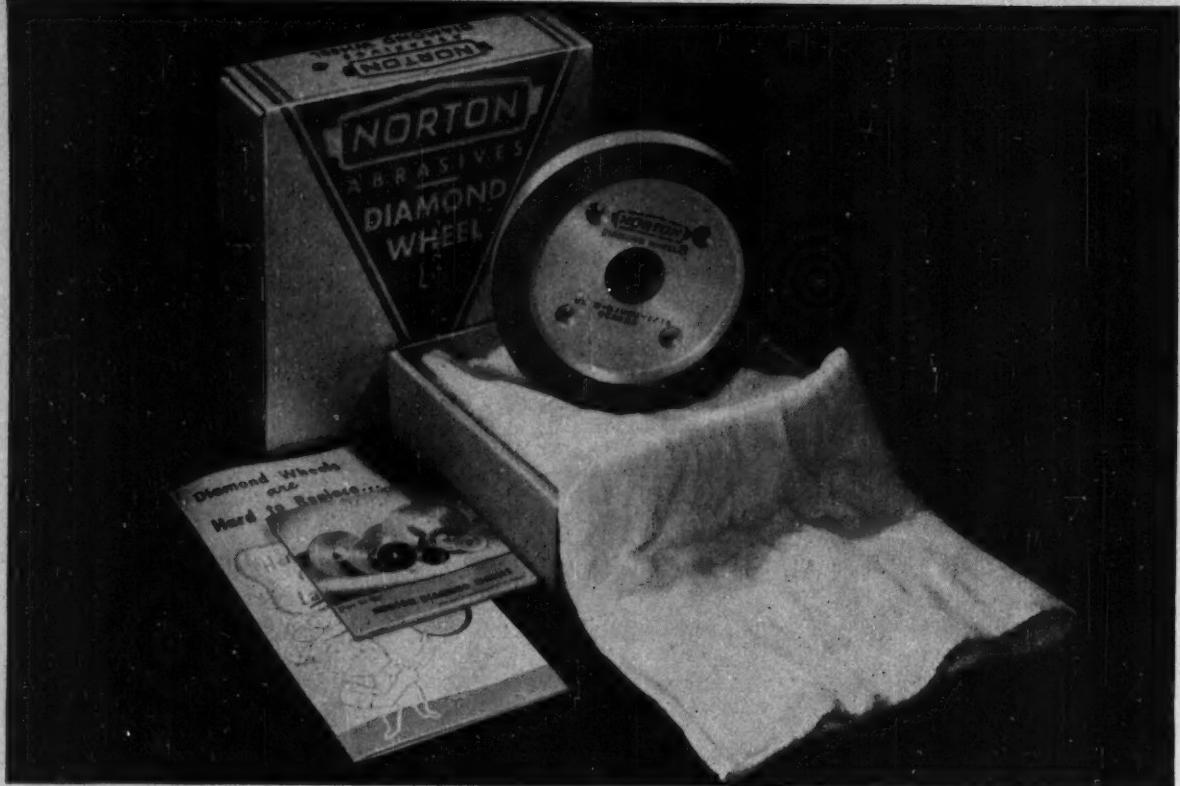


Photo courtesy of Norton Co., Worcester, Mass.

## Are your chemical products packaged as efficiently as these?

How important it is to provide proper shipping protection for your chemicals and chemical products! Shock, vibration, rough handling and even closure leakage can render an entire shipment worthless. That's why many leading manufacturers select Kimberly-Clark Interior Packaging—**KIMPAK\***, the modern interior packaging material of unlimited versatility that provides *custom protection* for every type of chemical and chemical product.

**KIMPAK** is soft and clean, conformable—easy to apply. It protects the most delicate product against shipping hazards. **KIMPAK** is feather-light, too,

yet gives more protection than most materials of far greater weight and density—an important factor in offsetting recent Parcel Post rate increases. And **KIMPAK** absorbs up to 16 times its own weight in moisture within 30 seconds to comply with regulations for mailing liquids.

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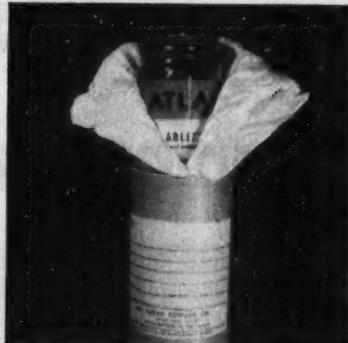


Photo courtesy of Atlas Powder Co.



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If CORROSION is a problem...



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In leading chemical plants, refineries, paper mills, textile plants, steel mills and hundreds of other industries HOMESTEAD Lever-Seald VALVES have virtually put an end to valve operating problems. Corrosive or viscous fluids, extremes of temperature or pressure or other adverse conditions that cause ordinary valves to stick or seize, simply cannot affect HOMESTEAD Lever-Seald VALVES. For built into each valve is a powerful lever-and-screw device that prevents sticking and assures positive action at all times, under all conditions in services ranging from 40° below zero to 1100° Fahrenheit.

HOMESTEAD Lever-Seald VALVES are available in straight-way, three-way, and four-way types, with screwed or flanged connections, in Semi-Steel, Steel, Ni-Resist, Stainless Steel, Monel or other alloys from 1" to 12", for vacuum to 1500 lbs. They are also furnished for pressure gun lubrication if desired.

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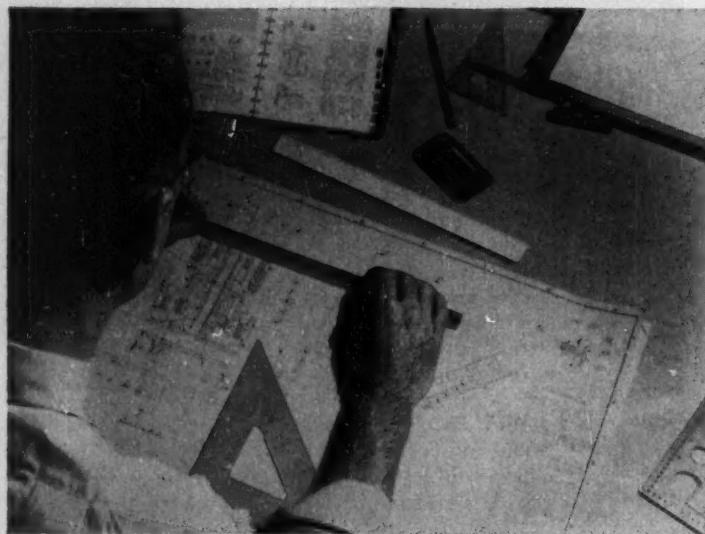


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When you sit down with Proctor engineers to discuss processing equipment you are availing yourself the benefit of a breadth and depth of experience that is virtually unequalled in any other single equipment manufacturer.

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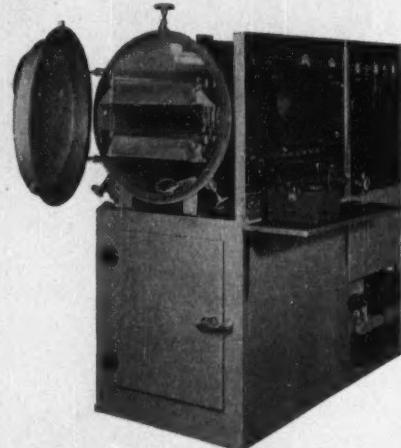
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## THE PROCTOR VACUUM-RADIANT HEAT FREEZE DRYING SYSTEM

Utilizes selective absorption radiant heat which results in shorter drying cycles, increased production and improved product.

Here is a patented method for drying heat sensitive materials, while frozen, that is finding wide application in drying products which must remain unchanged chemically or biologically after drying.

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Proctor freeze drying equipment of this type may be supplied in the form of a research unit, a commercial batch unit or a continuous system. Write for details.

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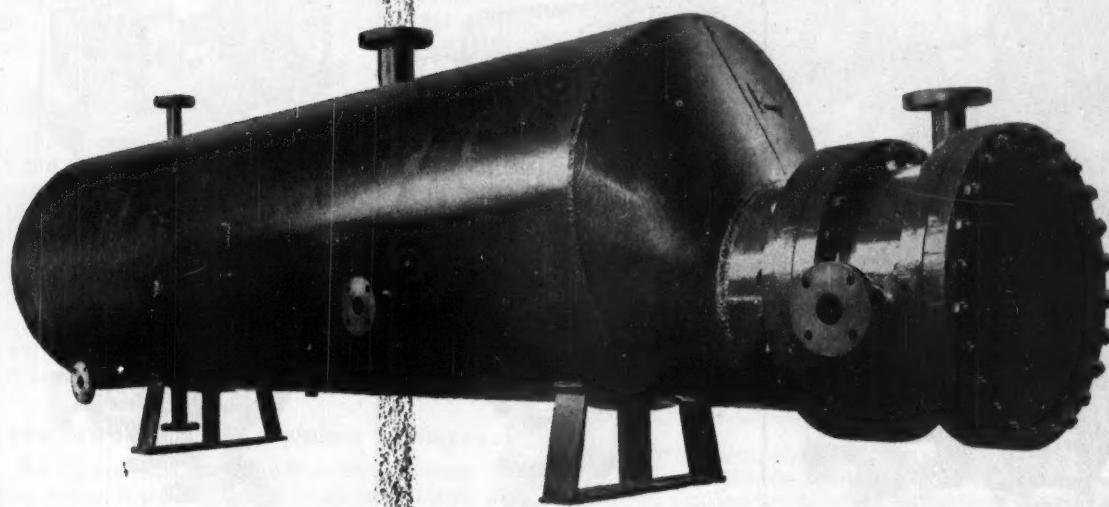
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p-k has designed and built dependable special purpose heat exchangers for years. This engineering and fabricating experience works to your advantage when you ask p-k for ideas on heat exchange problems. Your process may require special

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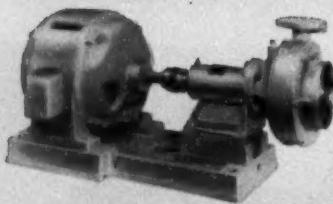
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**EVEN WATER** under certain conditions can impose a severe burden on pumping equipment. Add variables of viscosities, specific gravities and solids to difficult system head and capacity conditions and the pump problem can often only be resolved by

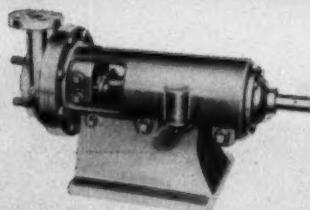
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# ALL SOLUTIONS ARE *chemical* SOLUTIONS!

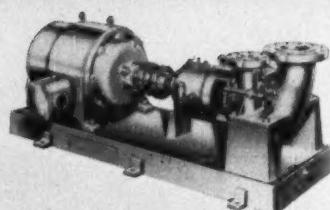
## Peerless HORIZONTAL PUMPS...



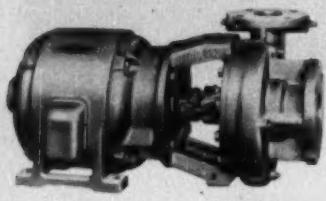
**FOR CHEMICAL TRANSFER SERVICE TYPE CTB**  
—A #20 alloy pump with mechanical shaft seal design.  
Described in Bulletin B-1606.



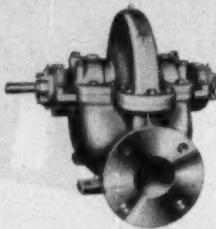
**FOR CHEMICAL PROCESS WORK TYPE DS**—  
A truly all purpose pump for higher heads and capacities.  
Described in Bulletin B-1600.



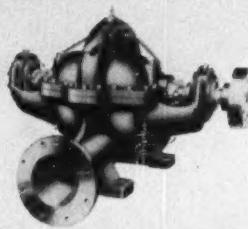
**FOR HEAVY DUTY PROCESSING TYPE PR**—  
Rugged center-line-mount design for hydrocarbons and process liquids.  
Described in Bulletin B-1603.



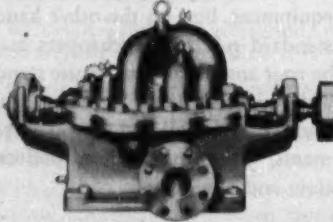
**ECONOMICAL ALL-PURPOSE PUMPS TYPES PE and PB**—Water handling pumps, available in widest range of sizes and hp.  
Described in Bulletin B-2300.



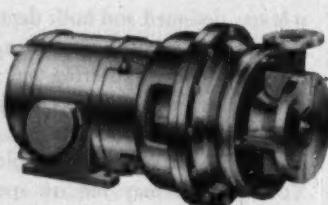
**PACKINGLESS WATER PUMP TYPE AS**—A mechanically shaft sealed, split case, general purpose pump.  
Described in Bulletin B-1250.



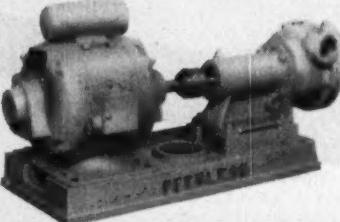
**SPLIT CASE HORIZONTAL PUMPS TYPE A**—  
Quality, performance and efficiency are paramount in this line.  
Described in Bulletin B-1300.



**2, 3, 4 and 5-STAGE PUMPS TYPE TU**—Multi-stage split case pumps for medium capacities at high heads.  
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**MAGNETIC DRIVE PUMP**—Liquid is confined to wetted end. Leakage eliminated. Revolutionary design.  
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**HOT OR COLD VOLATILE LIQUIDS TYPES TVE and TVB**—Turbine vane type pumps for clear or vaporous liquids.  
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# The Speedline system saves money on stainless piping and increases flow and capacity

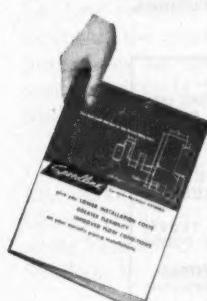
You can save money on your corrosion-resistant piping systems... perhaps even cut your costs in half. *Speedline* engineers have achieved these amazing results by using the new light wall stainless pipe and versatile *Speedline* Fittings. Here's the way it works:

## If you are now using Stainless Pipe...

... chances are that it is the conventional Schedule 40. But this heavy wall is not needed in 90% of the cases. Light wall Schedule 5 pipe costs about half as much, and all sizes will easily withstand 150 p.s.i. working pressures. *Speedline* Fittings are specially designed for fast, low-cost installation of light wall stainless pipe lines. And because light wall pipe of the same size has a larger inside diameter than heavy pipe, you gain 15% to 25% greater flow and capacity!

## If you are now using Stainless Tubing...

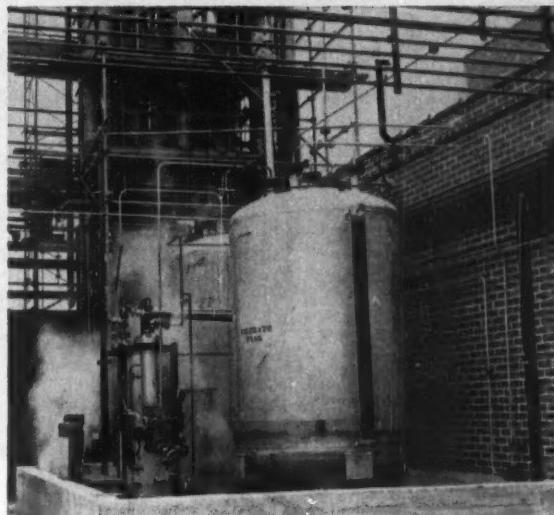
... the *Speedline* system offers real savings and advantages. It permits you to change to a light wall pipe rather than tubing size—at no increase in cost. And here's where you gain. Standard equipment like valves, pumps, sight gauges, etc., are made in pipe sizes—you hook right in without special adapters! And equally important, piping permits you to use the next lower dimension (for example, 1½" pipe has essentially the same capacity as 2" O.D. tube). This means that you can use smaller valves, flanges, and other accessories—an entire installation would be considerably lower in cost.



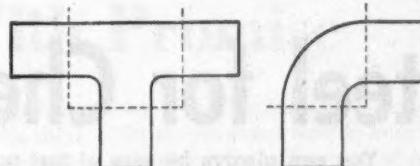
### WRITE FOR THIS FREE BOOK

Just write a note on your company letterhead and we will mail the *Speedline* catalog to you. It shows why you get better results at less cost with *Speedline* Fittings.

**Speedline distributors are located in principal cities from coast to coast**



Over 800 *Speedline* flanges are used in this installation by one of the largest chemical producers. Shortly after they were installed, a mishap occurred which caused the fluid to solidify in the lines, building up tremendous pressures. When the lines were put back into operation, not a single *Speedline* flange leaked!



### Look for the "Tangential Feature"

These drawings show a *Speedline* Tee and 90° Elbow. The dotted lines show the termination points of conventional fittings. The additional straight section of *Speedline* Fittings permits attaching of unions or flanges without fouling, reduces the number of welds required, and eliminates troublesome curved or angle joints. The tangential feature is common to all *Speedline* Fittings such as Ells, Tees, Crosses, etc.

**Speedline** **Corrosion-Resistant FITTINGS**  
*—the newest thing in pipeline economy*

Manufactured by **HORACE T. POTTS CO.** • Erie Avenue & D Street • Philadelphia 34, Penna.



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You can have your steel cut to size, too, and you can always depend on Ryerson quality. So for every steel requirement, call your nearby Ryerson plant.

### PRINCIPAL PRODUCTS

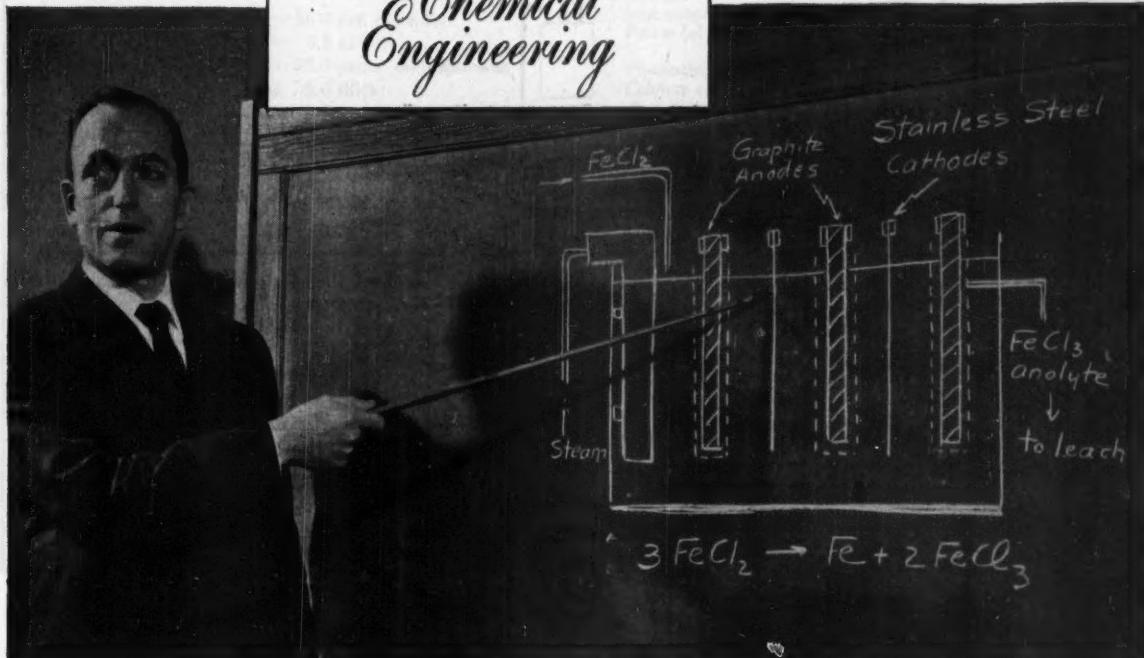
CARBON STEEL BARS—	ALLOYS—Hot rolled, cold finished, heat treated
Hot rolled & cold finished	STAINLESS—Allegheny bars, plates, sheets, tubes, etc.
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APRIL  
1953

# Chemical Engineering



The author tells how chemical engineering gives metallurgy what's in effect a new metal, extremely pure malleable iron from waste pyrrhotite. It's an . . .

## Electrolytic Process With Promise

### ERICH KONRAD

Pure dense iron, because of its unusual physical and electrical properties, has long intrigued metallurgists. But except as the powder, extreme high-purity iron has never been generally available in the U. S. on a commercial scale.

This situation may soon be changed. For Sulphide Ore Process Co., working under the sponsorship of George A. Ellis and F. A. Eustis as well as the Vermont Copper Co., Inc., of S. Strafford, Vt., has developed a process

to produce up to 99.99 percent iron in the form of dense, malleable sheets. Patents covering the operation are owned by the Sulphide Ore Process Co.; plans for putting up a commercial plant are now well under way.

Raw material for the process is pyrrhotite\*, the monosulfide of iron, a waste product of many mining and milling operations. Mining men estimate that North America wastes 10,000-15,000 tons of iron and 6,000-9,000 tons of sulfur each day in the pyrrhotite discarded. Therefore, recovery of these essential materials gives the process a double-barreled advantage.

The process itself is an electrolytic

one which produces pure, dense, malleable iron sheets directly from ferrous chloride solution by means of graphite anodes and stainless steel cathodes.

### RAW MATERIAL IS CHEAP

A great deal of work has been done on electrolytic iron over many decades\*. But the Sulphide Ore process is believed to be unique in one respect: it's the only one based on the recovery of iron directly from a low-grade ore.

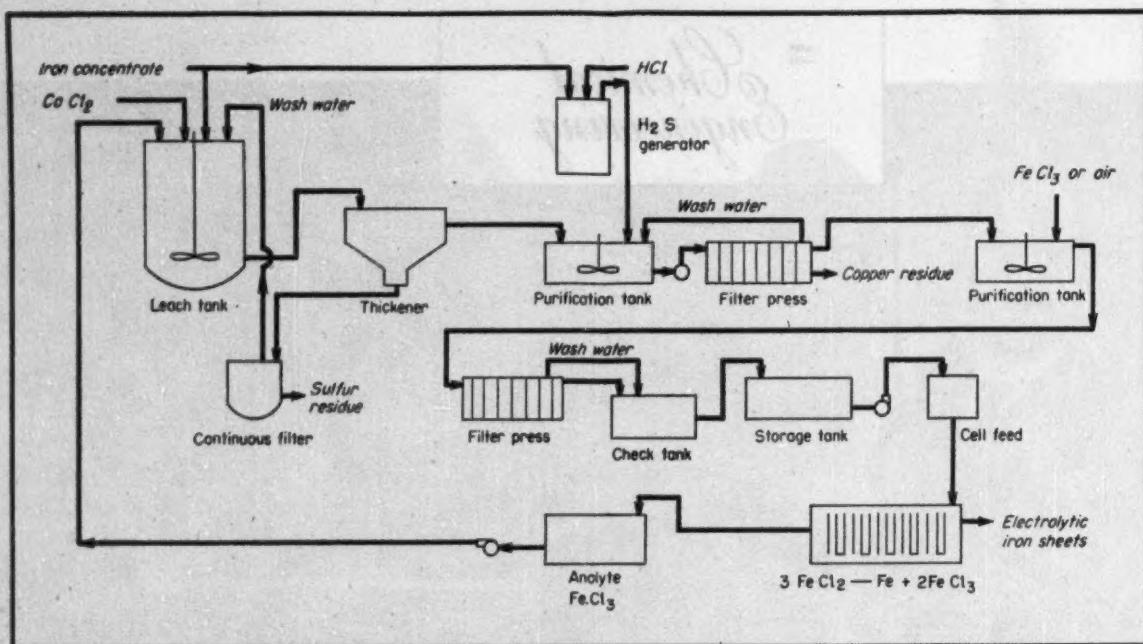
Raw material used in pilot plant work at the University of Vermont was the waste pyrrhotite (mono-sulfide of iron) concentrates from the copper

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ERICH KONRAD supervised development of the Sulphide Ore process as director of the Metals Research Laboratory at the University of Vermont. He has since become affiliated with the American Platinum Works in Newark, New Jersey.

\*Though pyrite, the double sulfide of iron can't be used in this electrolytic process, it can be converted to pyrrhotite by distilling off one atom of sulfur at 500-700 deg. C. under a protective atmosphere of  $\text{SO}_2$ .

\*The Sulphide Ore process brings to conclusion earlier work by Eustis and Perin who operated a pilot plant at Milford, Conn. in 1922, and later by J. R. Cain of the Bureau of Standards, working with Eustis, who contributed much to the knowledge of proper cell conditions. Both Eustis and Cain were advisors to the present work.



operations of Vermont Copper Co. at South Strafford, Vt. After the copper-bearing chalcopyrite is recovered by selective flotation, tailings from the flotation circuit average 20 percent iron as pyrrhotite.

At its present mining rate, Vermont Copper discards daily about 700 tons of tailings containing 140 tons of iron and 85 tons of sulfur. Furthermore, the South Strafford mine already has a tailings pond with an estimated million tons of material equivalent to 200,000 tons of iron and 120,000 tons of sulfur.

#### PROCESS IS CYCLIC

Starting material is iron concentrate produced by simple flotation from pyrrhotite tailings. This concentrate (assaying 56-58 percent iron, 33-35 percent sulfur, 0.3-0.5 percent copper and 2.5-5 percent insolubles) can come directly from the mill tailings stream or from the tailing pond.

Direct cost of producing concentrate is low (about \$0.25 per ton). But by letting the pyrrhotite carry some of the mining and milling costs, the economic balance of the copper operation shifts making possible the exploitation of lower grade ores. Therefore, in the cost calculations, the price of iron concentrate has been assumed to be \$5.00 a ton—including handling and transportation within 300 miles of the mill.

Pyrrhotite from the mill (12-15 percent moisture) is fed to a hot, agitated solution of ferrous and ferric chloride. During the leach reaction iron is taken into solution and the ferric chloride is reduced to ferrous chloride.

The leach reaction is rapid at 90-95 deg. C., lending itself to continuous operation. Each stage (mean reaction time: 6 hr.) gives an extraction of 75-80 percent of the iron contained in the concentrate feed; three stages will give an extraction of 97 percent. Any copper in the iron concentrate will give the same percentage of extraction.

Ferrous-ferric chloride solution flows continuously from the anode compartments of the cells to the leach tanks. Completely reduced ferrous chloride solution goes to a Dorr thickener where the reaction product, sulfur, plus unreacted pyrrhotite is settled out. The spigot is run to a continuous filter; overflow to purification tanks.

Impurities, because of their deleterious effect on the cell if allowed to remain in solution, are precipitated as the metallic sulfides by treatment with hydrogen sulfide gas (generated by reacting pyrrhotite with hydrochloric acid in a Kipp type generator). The metallic sulfides are then filtered out on an acid-proof Shriver press, and since the predominating impurity is copper, the press cake has some value.

Excess hydrogen sulfide gas is removed in a second purification tank either by aeration or by the addition of ferric chloride solution from the cell circuit. The resulting suspension of fine sulfur is removed by a clarifying filtration through another Shriver press and the solution run to one of several alternating check tanks. Here the solution is held until its suitability for electrolysis is verified. If necessary the pH and the concentration are adjusted by addition of hydrochloric acid and water. If found satisfactory, the solution is run to storage for distribution to the cells.

During the leach reaction, a side reaction produces sulfate, chiefly in the form of sulfuric acid (3 percent of  $\text{FeCl}_3$  reduced). Most of this can be precipitated by maintaining a  $\text{CaCl}_2$  concentration of 15 grams per liter; the precipitate is then removed with the leach residue.

The process is entirely cyclic and only drag-out losses need be replaced. Replacement is made chiefly from ferrous chloride solution produced in the hydrogen sulfide generators. During more than two years of continuous operation, there was no detectable build-up of harmful impurities. Since the process runs hot, there is considerable evaporation of water, but wash water from various parts of the process very nearly balances this loss.

### **Material Balance, 5 Tons Iron/Day**

<b>Raw material</b>	
Pymhotite concentrate.....	Fe — 56.0 pct. as $Fe_{13}S_{18}$ Cu — 0.5 as CuS S — 35.0 (metal sulfide) Insol 6.0 silica Other 2.5 (metal sulfide)
Dry weight.....	18,350 lb.
Wet (12 pct. H <sub>2</sub> O)....	20,850 lb.
Calcium chloride .....	920 lb.
<b>Products</b>	
Electrolytic iron sheets.....	2X3 ft., 99.95 percent
Weight.....	10,000 lb.
Sulfur residue.....	Fe — 3.0 pct. S — 68.1 as free S, FeS CaSO <sub>4</sub> — 11.8 Insol — 12.1 Other — 5.0
Dry weight.....	9,124 lb.
Wet (12 pct. H <sub>2</sub> O)....	10,350 lb.
Copper residue (as sulfide).....	80 lb.
<b>Over-all extraction</b>	
(3 stage leaching).....	97 percent
<b>Material handled</b>	
In.....	21,770 lb. wet
Out.....	20,430 lb. wet

#### **CELL IS VERSATILE**

Graphite anodes surrounded by diaphragms and stainless steel cathodes comprise the cell; as iron is deposited on the cathodes,  $\text{FeCl}_3$  is formed at the anodes. The anolyte is withdrawn continuously at a controlled rate and cycled back to the leach; fresh  $\text{FeCl}_3$  is fed to the cell from storage.

Level controls at the anode adjust fresh solution feed to equal withdrawal; no electrolyte circulation is necessary beyond this. Rate of solution feed and withdrawal is a compromise between good cell operation and circulating load; optimum rate is four gallons per pound of iron deposited. The porosity of the anode diaphragm allows no back diffusion of  $\text{FeCl}_3$  at this rate of flow.

The nature of the deposit can be varied by varying the cell temperature. At 20-30 deg. C. a very brittle deposit is formed and this can readily be ground to powder; at 90 deg. C. a coherent, malleable sheet of the same density as rolled stock is formed. Thus, by varying conditions, either dense iron sheets or brittle material for powdered iron can be made.

Size of the deposit depends on the cathode. Deposits have been made measuring up to 3 ft. by 4 ft. Thickness of the deposit varies with the time of deposition. Deposits measuring from 0.002 in. to 0.250 in. have

**Estimated Operating Costs,\* 5 Ton/Day Plant**

\* Estimate does not include credit for sulfur or copper.

been made. However, there is a decrease in the current efficiency after the deposition time passes 24 hours. For the sake of simplicity, all the calculations in this article have been based on the production of malleable sheet.

Closely controlling purity of solution and equipment keeps the sheets to a thickness variation of no more than 5 percent. When deposits have built up to the desired thickness, the cathode is lifted out of the cell and drained, and the adhering electrolyte is taken off with live steam. The deposit is then stripped with the help of a suitable tool. The cathode is prepared by washing off any adhering electrolyte, drying, and coating with a very thin layer of colloidal graphite (which doesn't affect the analysis of the deposit).

#### **POWER CONSUMPTION IS LOW**

Cell power consumption depends on current efficiency and cell resistance which depends, in turn, on current density. At power costs of 0.8-1.0¢ per kwh the optimum between capital investment on cells and power costs dictates current density of 40-50 amps per sq. ft. A cell approaching a commercial cell in size was run at this current density for several years and showed a current efficiency of 90 percent and a voltage of 3.0 for a calcu-

lated power consumption of 1.5 kwh per pound of cathode iron produced. Some test work has been done on the use of a porous graphite anode which acts also as a diaphragm. By the use of this anode, iron was produced at the very low power consumption of 1.0 kwh per pound.

#### **PRODUCTS: SULFUR**

The leach residue contains up to 75 percent total sulfur, the balance being undissolved pyrrhotite and insoluble gangue. Methods of recovering the sulfur in pure form have been given some study although the emphasis has been on the iron process. The free sulfur in the residue has a particle size of 0.5 to 5.0 microns while the undissolved FeS particles show a size of over 20 microns. In spite of this difference, though, they cannot be separated by simple flotation or gravity methods. Instead, distillation, melting, or extraction of the sulfur with hot kerosene followed by cooling to crystals, would probably be successful.

None of these methods has been studied exhaustively, though, and it will be best to find an immediate market for the residue in the sulfur burning industries. Possible returns from this source have not been calculated.

## AND PURE IRON

### **The outstanding characteristic of the**

### Estimated Capital Cost, 5 Ton/Day Plant

<b>Tank house</b>	
Haveg cells (22 at \$1,000)	\$22,000
Anode assemblies (including diaphragms, cross bars, at 33.48)	17,700
Stainless steel cathodes including cross bars, 504	14,100
Concrete wash cells, 4	500
Launders and piping	3,000
Karbite immersion heaters, (22 at 200)	4,440
10,000 lb. aluminum bus bar	3,000
<b>Total</b>	<b>\$64,700</b>
<b>Leaching and Purification</b>	
2 leach tanks, capacity 20,000 gal. steel, acid brick lining	18,000
1 Dorr thickener, 12 ft. dia. × 8 ft. steel, rubber lined	4,250
1 continuous Oliver filter, 4 × 4 ft.	7,300
1 hydrogen sulfide turbo mixer	1,000
1 Air turbo mixer	1,500
2 filter presses, 36 × 36 in., wood	3,000
2 solution check tanks, 10 ft. dia. × 12 ft., concrete	3,000
2 solution storage tanks, 15 ft. dia. × 18 ft.	7,000
2 Haveg tanks, 8 ft. dia. × 8 ft. for cell feed and anolyte surge	2,400
1 hydrogen sulfide generator	1,000
1 absorption tower, 6 × 8 ft., Haveg	1,500
6 Olivite pumps, 2 × 2.5 in.	3,900
1,000 ft. Haveg pipe and fittings	6,500
<b>Total</b>	<b>\$60,350</b>
<b>Power Converter</b>	
Motor generator, 10,000 amp, 66-75 v.	55,000
1 reduced voltage starter	4,000
1 voltage regulator	700
<b>Total</b>	<b>\$59,700</b>
<b>Buildings</b>	
7,000 sq. ft. of 15 ft. av. height, at \$0.50/cu. ft.	50,000
<b>Total equipment, building cost</b>	<b>\$281,900</b>
<b>Plus 30 percent installation</b>	<b>\$84,440</b>
<b>Total Capital Cost</b>	<b>\$365,600</b>

iron produced by this method is its high degree of purity. As deposited, the iron contains some hydrogen. When this is removed by low temperature annealing, the resultant sheet becomes very malleable and can be applied directly to its end use. Iron produced during the last year of pilot plant operation averaged 99.96 percent, and analyzed typically:

C	—	0.002 percent
Cu	—	0.005
Si	—	0.001
S	—	0.005
Mn	—	0.001
P	—	0.002
Ni	less than	0.001
Co	—	0.001
Zn	—	0.001

Fe by difference     99.98 percent

Larger units, it is estimated, will consistently produce iron of 99.99 percent purity. Iron produced by this process won't directly compete with existing ferrous materials. It's in effect a new metal, which because of its purity will find special markets like: special alloys where low carbon and sulfur contents are important; extreme

cold working operations (pure iron has working properties akin to those of copper and can be subjected to severe drawing and rolling operations without intermediate heat treatment); electromagnetic applications (maximum permeability is approximately twice that of magnetic ingot iron and the coercive force is only one-half).

In addition, the iron lends itself well to glass and enamel coating. Tests along these lines also indicated an unusual hot strength which allows it to be supported in strip form in the vertical furnaces, used in the firing of the enamel, without warpage or distortion.

These markets were investigated to the limit of the 100-pound pilot plant capacity and results look promising.

#### BIG MATERIALS PROBLEM CONTROLLED

One of the biggest problems of earlier investigators in this field was the lack of available materials of construction possessing suitable properties. Iron chloride solutions are notoriously corrosive, especially in the

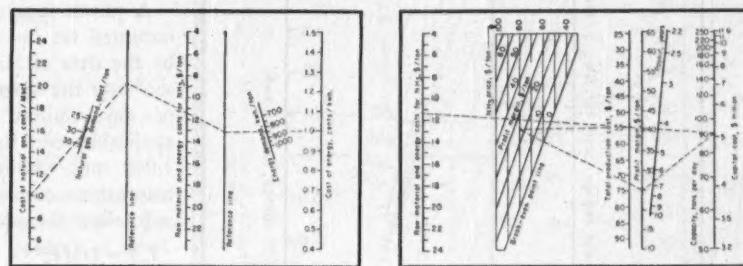
<b>Miscellaneous</b>	
Electrolyte, 100,000 gal. at \$0.11	11,000
1 compressor	600
1 boiler, 160 hp	10,350
Heating and plumbing materials	3,600
Lighting fixtures	2,900
Power equipment	2,000
Storage for ore and residues	6,000
Repair shop, shipping, control lab	5,000
Materials handling equipment	5,000
<b>Total</b>	<b>\$46,450</b>

### Cell Operating Data, Production: 5 Tons Iron/Day

<b>Number of cells</b>	<b>22 (20 + 2 standby, series conn.)</b>
<b>Power per cell, dc.</b>	<b>10,000 amp, 3.0 v, 720 kwh/24 hr., cell efficiency 90 percent, 1.6 kwh/lb. Fe.</b>
<b>Duration of run</b>	<b>Variable, depending on sheet thickness desired. Build-up 0.002 in./hr.</b>
<b>Anodes</b>	<b>Size finished sheet: 2 × 3 ft. Graphite surrounded by Vinyon-N diaphragm, 22/cell, 22 × 40 × 1 in.</b>
<b>Cathodes</b>	<b>Active cell area: 225 sq. ft., current density: 45 amp/sq. ft. Anolyte: 150 g/liter total iron, 60 g/liter ferric iron (as chloride). Flow: 80 gal./cell/hr. = 4 gal./lb. iron. Est. life of anode and diaphragm: 2 yr. Stainless steel, 21/cell, 24 in. × 41 in. × 11 gage, 252 sq. ft. active area/cell. Current density: 40 amp/sq. ft. Catholyte: 150 g/liter total iron, ferric iron — nil to trace. Flow: 80 gal./cell/hr. Est. life: 1 yr.</b>

oxidized state. It is only in the last few years that new materials have come along to withstand the action of these solutions over long periods. Concrete, properly treated, has been found suitable for tank materials where temperatures are not excessive (as in storage tanks). Chlorinated rubbers, such as Neoprene resistant up to 90 deg. C., are well suited for tank linings and solution lines. Haveg is an ideal material for tanks, pipe lines and pumps, showing no corrosion wear whatever when used up to a temperature of 100 deg. C. for several years. For cell diaphragms and filter cloth the recently developed plastic cloths made of saturated vinyl chlorides are well suited. They show remarkable heat stability and corrosion resistance and almost no shrinkage. Glass has been used for pumps but has the disadvantage of being fragile. For pumping completely reduced  $\text{FeCl}_3$  solutions, high silicon ferrous alloys of the Duriron class performed well. For cell heaters, Karbite steam immersion heaters were found most suitable.

# Simplify Your Cost Estimates . . .



by presenting the results in the form of nomographs. A few, carefully planned, can present a complete economic picture, eliminating the need for a large number of graphs and tables.

L. LYNN and J. R. McKLVEEN

Integrated and meaningful portrayal of the economics of a manufacturing enterprise involves the interplay and combination of many diverse independent variables. A comprehensive economic study customarily requires a multitude of graphs and tables to show the relationships of such factors as:

Raw material costs, process conversions and efficiencies, charges for utilities and services, labor charges, tax and insurance rates, indirect factory costs, depreciation and interest schedules, profit margins, sales values, plant capacities, operational levels, cash position, payouts, break-even points and others.

This article deals with the use of nomography as a tool in such economic studies. We have found it to be a valuable means of integrating seemingly isolated components of a complex situation into a meaningful entity.

Among the advantages of nomography in this field are the following:

The rapidity and simplicity with which a nomograph can be used in considering three, four, five or more economic variables.

The ease with which the interplay between several variables can be studied simultaneously.

Interpolations between the curves of conventional graphs are obviated; they can be made along conveniently graduated scales.

The number of charts or graphs nec-

essary to explain a complex problem is greatly reduced.

Nomographs allow a continual re-evaluation of the chances for economic success of a project as research progresses, as yields change, as the raw materials picture shifts and as the market for the product fluctuates.

Such a tool would be extremely useful in the economic analysis of

several processes of current widespread interest. Study of the economics of coal hydrogenation—the subject of much controversy—could be greatly facilitated. The same is true for aromatization of petroleum fractions, recovery of sulphur from H<sub>2</sub>S-containing gases, synthetic rubber, or the use of natural gas vs. coal as raw material for ammonia synthesis.

## Economics of NH<sub>3</sub> Production, for Example

In order to demonstrate these methods, the production of ammonia from natural gas is used as an example. We shall consider these points:

1. How does cost of ammonia vary with price of natural gas and over-all yield of the process?

2. How does cost of ammonia vary with power charges?

3. How do cost and venture payout for an ammonia plant vary with plant capacity when the plant is operating at 100 percent of design capacity?

4. How do cost and venture payout vary for a plant whose capacity is fixed but whose operational level varies, and what is the break-even point?

5. How do cost and venture payout vary with fluctuations in market price for plants of varying sizes and operational levels?

These questions are all of immediate and understandable concern to management. The answers to them should be made available in the quickest, clearest and most concise manner possible.

Recent literature contains several

cost estimates which cover ammonia production via standard processes. The data of Ferencz<sup>1</sup> will be used as our general basis, organized in the form of the table on the next page.

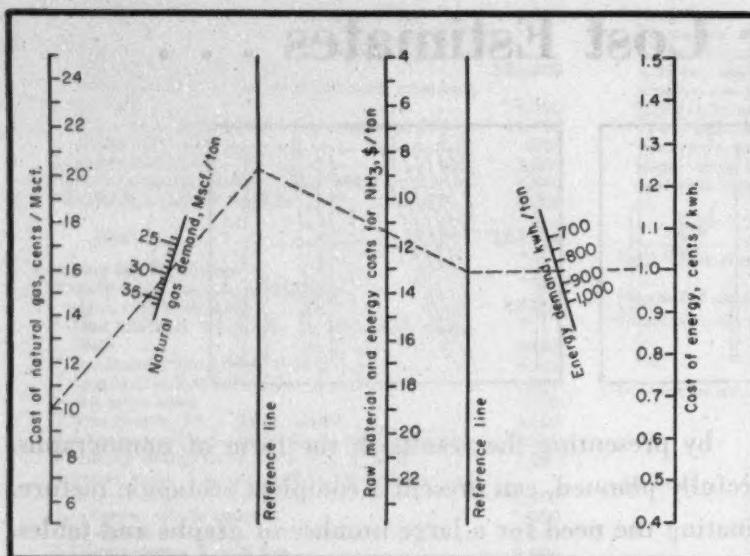
### NATURAL GAS AND ENERGY COSTS

We must first establish the range of interest or reasonableness for each of the variables under study and the functional relationships of these variables.

The data of Hein,<sup>2</sup> Ferencz<sup>1</sup> and Tuttle<sup>3</sup> indicate the consumption of natural gas by a plant using gas as both fuel and raw material to be from 24,000 to 36,000 std. cu. ft. per ton of product. The natural gas cost scale should be sufficiently broad to cover the gradually increasing price of gas and the widespread differences in gas price due to purely local considerations. A range of 5 to 25c. per 1,000 std. cu. ft. should satisfy these circumstances. Energy consumption will be charged in the range of 700 to 1,000 kwh. per ton at a price of 0.4 to 1.5c. per kwh.

Grouping natural gas cost and elec-

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RAW MATERIAL and energy costs vs. unit prices and demands.

trical energy cost in one nomograph (see above) is convenient for two reasons: These cost elements are particularly variable with plant location, and the information in the other nomographs is dependent on these data. If the cost of electrical energy per ton of product were negligible, or even if it were fairly constant, we could group it with steam and water and consider it as one of the cost elements in the other two charts.

(In processes which involve two or more different raw materials, such as ethyl alcohol and acetic acid for ethyl acetate, it is convenient to group all raw materials on one nomograph, each with its own yield or material demand scale in convenient units, such as lb.

#### Production Cost of Ammonia

(Based on 30,000 tons/yr. at 90% stream efficiency, or 91 tons/day)

	\$/Yr.	\$/Ton
<b>Raw Material and Supplies</b>		
Natural gas, 25.42 Mcf./ton @ 7.5¢/Mcf.	87,200	1.91
Catalyst and supplies.....	99,000	3.30
	186,200	5.21
<b>Labor</b>		
Labor, direct.....	302,500	10.08
Supervision and laboratory.....	55,000	1.83
	357,500	11.91
<b>Services</b>		
Steam and water.....	34,400	1.15
Electric power.....	163,500	6.45
	197,900	6.60
<b>Maintenance and Repairs</b>		
4.55% /yr. on \$5,160,000 investment.....	235,000	7.53
<b>Taxes and Insurance</b>		
2% /yr. on \$5,160,000 investment.....	103,380	3.45
<b>Factory General</b>		
29.7% of above excluding raw material, supplies, power.....	216,620	7.10
Depreciation 5% /yr. on \$5,160,000 investment.....	258,450	8.61
<b>Total</b> .....	1,525,050	50.80

per gal., lb. per lb., or simply percent efficiency. Such a nomograph would determine total raw material cost.)

It is simple enough to construct a nomograph such as shown above using graphical shortcuts.<sup>6,7</sup> However, since power functions appear in most cost equations, it is better to adopt the methods and theory described in any good reference text on nomography, such as Davis,<sup>8</sup> for all these charts.

#### EFFECTS OF PLANT SIZE

In studying the total cost of ammonia over a reasonable range of plant capacities, let us assume 50 to 250 tons per day as the range of interest. The total cost of ammonia C can be evaluated from the basic data of the table and a knowledge of how the individual cost elements vary with plant capacity.

The variation in labor cost L with production P over the range of 200 to 400 tons per day is found to follow the 0.82 power, based on estimates by Skinner, Batchelder and Katell.<sup>9</sup> Our own estimate of the exponent for the range 50 to 250 tons is about 0.90. Thus,

$$L_0/L = (P_0/P)^{0.9}$$

Maintenance cost variation can be shown also to correspond to the 0.9 power. Thus,

$$M_0/M = (P_0/P)^{0.9}$$

The variation in taxes and insurance T and depreciation D depends on the relationship between investment and capacity. This assumes that, regard-

less of plant capacity, 2 percent of investment is charged as annual allowance for taxes and insurance and 5 percent for depreciation.

A power function of 0.77-0.78 is indicated for investment vs. capacity by the data of Shearon and Thompson<sup>1</sup> over the range of 60 to 180 tons per day. Chilton<sup>1</sup> reports 0.81 to be applicable over the range of 120 to 1,000 tons. Assuming 0.80 to be a reasonable compromise, plant cost I will follow the equation

$$I/I_0 = (P_0/P)^{0.8}$$

Therefore

$$T/T_0 = D_0/D = (P_0/P)^{0.8}$$

Total cost can be expressed as

$$C = G + E + K + L + W + M + T + F + D$$

where G is the cost of natural gas, E is energy, K is catalyst and supplies, W is steam and water and F is factory overhead, all expressed on the basis of a unit of product. (The other terms have been defined previously.)

We can now substitute into this equation the previously derived expressions relating L, M, T and D with P, also the numerical values from the table:

$$C = (G + E) + 3.30 + 1.297 \\ [11.91(P_0/P)^{0.8} + 1.15 + 7.83(P_0/P)^{0.8} \\ + 3.45(P_0/P)^{0.8}] + 8.61(P_0/P)^{0.8}$$

P<sub>0</sub> now refers to a definite production capacity, 91 tons per day, and P varies from 50 to 250. Substituting and combining terms,

$$C = (G + E) + 4.79 + 482/P^{0.8} + \\ 1,485/P^{0.9}$$

Knowing the relationship of I with P, we may next establish the capital cost scale. Since the power function of 0.80 involved in the capital cost scale is not identical with that of the capacity scale in the above equation, a small error will be introduced in the capital cost and payout scales. The error amounts to only a few percent and is well within the limits of precision of this study.

Arbitrarily selecting a price scale S of \$30 to \$100 per ton, we fix the profit margin scale N by the equation

$$C = S - N$$

The N scale can be constructed, in this case, from zero to \$70 per ton. The zero margin is a linear representation of the 'break-even point' of the project. Using this scale we can study those conditions of price and cost which will result in operation at zero profit.

The payout scale  $R$  is determined by the equation

$$R = I/NP$$

But  $I$  may be expressed in terms of  $P$ , leading to the equation

$$R = I \cdot P^{0.3} / NP^{0.8}$$

in which only two variables,  $R$  and  $P$ , appear.

#### EFFECT OF OPERATING LEVEL

Our third nomograph shows the effect of plant operating level, over the range of 50 to 110 percent of rated capacity of the plant, on ammonia cost, profit margin, break-even point and payout. In general, the method of preparation parallels that employed for the other summary nomograph. The plant under study is rated at 91 tons per day or 30,000 tons per year. For this operating level range, it can be shown that ammonia cost  $C$  is given by

$$C = (G + E) + 4.79 + 3,868/O$$

where  $O$  is the operating level expressed in percent.

The equation

$$R = 17,200/O$$

describes the variation of payout with operating level and profit margin.

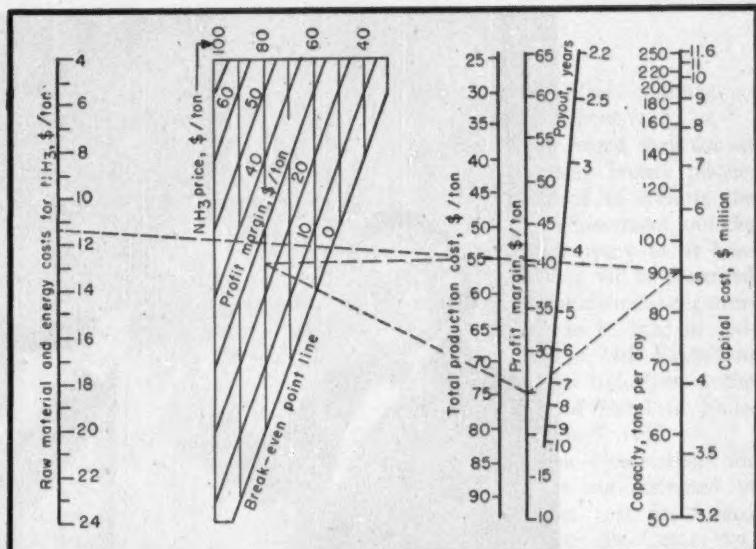
#### HOW TO USE CHARTS

1. With natural gas at 10c. per 1,000 std. cu. ft. and electrical energy at 1.0c. per kwh., if a plant requires 30,000 std. cu. ft. of gas and 850 kwh. per ton of product, what is the combined gas and energy cost?

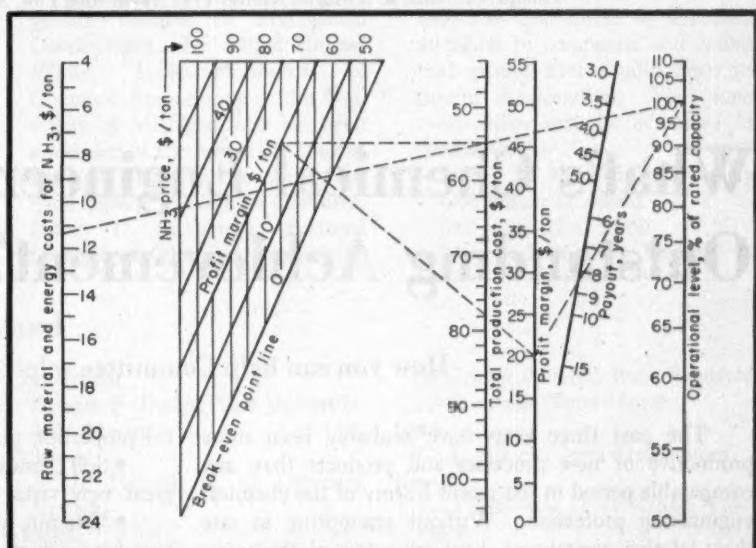
Connect the gas cost and demand with the gas reference line on the first nomograph. Connect the energy cost and demand with its reference line. The two reference points so determined are connected, locating the combined cost at \$11.50 per ton.

2. A plant rated at 91 tons per day operates at a gas and energy cost of \$11.50 per ton and sells ammonia at \$80 per ton. Find the total ammonia cost, profit margin, plant cost and payout.

On the second nomograph, connect the \$11.50 gas and energy cost with 91 on the capacity scale; this intersects total production cost scale at \$55 per ton. Connecting this cost horizontally with an \$80-per-ton price shows a \$25-per-ton margin. Connecting 91 tons per day to a \$25-per-ton margin intersects the payout scale at 6.7 years.



SUMMARY of production economics for plants of varying capacities.



SUMMARY for a fixed-capacity plant operating at various levels.

The plant cost, read opposite the capacity, shows roughly \$5.1 million.

3. Given the gas and energy cost of Example (1), a \$75-per-ton market price and a 91-ton-per-day plant operating at 100 percent capacity, find the cost of ammonia, the profit margin and payout.

Using the third nomograph in the manner described for Example (2) gives a \$55-per-ton cost, a \$20 margin and an 8.5-year payout.

#### ACKNOWLEDGMENT

We wish to express our sincere appreciation to the Celanese Corp. of America for granting permission to

publish this article, and to Henry K. Dice and Robert L. Mitchell for their encouragement in this work.

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Phillips' Chairman K. S. Adams receives 1951 Award from Prof. A. H. White.

# What's Chemical Engineering's Outstanding Achievement?

How you can help Committee select recipient for the 1953 Award.

The past three years have probably been more productive of new processes and products than any comparable period in the recent history of the chemical engineering profession. Without attempting to rate their relative importance, here are a few of the many projects that have come to commercial fruition since January, 1950:

- Antibiotics, in greater profusion, with properties tailored for animal and plant as well as human health.
- Benzene, toluene, xylene from petroleum now seriously threaten coal-tar sources.
- Chemical reduction processes challenge the time-honored metallurgy of copper, nickel and cobalt.
- Chemico-therapy advances as organic chemical syntheses dominate drug industries.
- Coal hydrogenation for the production of chemicals at last reaches commercial feasibility.
- Ethylene-derived petrochemicals project a growth of 2½ times in next 10 years.
- Fertilizers, insecticides and fungicides take over major role in agricultural economy.
- Fibers, man-made for specific physical and chemi-

cal properties, push for bigger share of textile market.

• Soil conditioners, chemically derived, open a great new vista for scientific agriculture.

• Vitamin syntheses overcome dependence on nature for products essential to human, animal and plant nutrition.

Common denominator of all of such developments in the chemical process industries is teamwork between technology and management—group efforts in which chemical engineers of many talents have played vital roles. So it is appropriate that our award, in contrast with most medals and similar honors, should go to a company rather than to any individual.

You can help the committee in its difficult problem if you will pass along your nominations and suggestions to the secretary or to any member of the 1953 Award Committee.

## Rules and Regulations

**Purpose**—The Award for Chemical Engineering Achievement is made to recognize the results of group effort—of teamwork among executive, engineering, research, production and sales divisions of a corporate organization. It is presented to a company or a department within a company rather than to any individual. Thus it serves the dual purpose of (1) recognizing an outstanding group accomplishment and (2) at the same time calling attention to a company in the process industries that has encouraged its chemical engineers to participate broadly in all of the affairs of the industry and profession.

**Eligibility**—The Twelfth Award for Chemical Engineering Achievement will apply only to industrial developments that have come into commercial fruition or have become known publicly since January 1950. All nominations must be received by the Secretary of the Committee of Award not later than May 15, 1953. They should contain the following information:

(a) What is the nature of the

- company's achievement?  
(b) During what period has it come into commercial fruition?  
(c) To what extent have chemical engineers participated in its development?  
(d) Are supplementary records, data, articles or references available to the Committee in order that it may give fair consideration to this achievement and to the company's personnel and employment policies?

**Judges**—The Committee of Award shall consist of the heads of chemical engineering in all of the educational institutions of the United States whose courses are now accredited by the American Institute of Chemical Engineers and the Engineers' Council for Professional Development. Dr. Alfred Holmes White, Professor-Emeritus of Chemical Engineering at the University of Michigan who has been a member of the Award Committee since its inception in 1933, has again agreed to serve as chairman. Sidney D. Kirkpatrick, Editorial Director of Chemical Engineering

and Chemical Week, continues as Secretary but without vote.

**The Award**—The Award shall consist of an appropriate bronze plaque, suitably embossed to indicate the nature of the achievement and the name of the company to be honored. The Award will be presented at a dinner of the chemical engineering profession to be held in connection with the 24th Exposition of the Chemical Industries at the Bellevue-Stratford Hotel in Philadelphia December 2, 1953.

**Your Participation**—Nominations for this Award are not restricted to those companies that file formal applications with the Committee. Suggestions are desired immediately from any and all sources that will help the Committee by directing attention to companies and industrial groups that should have its careful consideration. Your communications may be addressed in confidence to

Sidney D. Kirkpatrick, Secretary  
Committee of Award  
330 West 42nd Street  
New York 36, New York

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Olaf A. Hougen, U. of Wisconsin, Madison 6

## Recipients of Previous Awards

- 1933 Carbide & Carbon Chemicals Corporation**—the original award was made for producing commercially a large number of synthetic organic chemicals from petroleum and natural gas.  
**1935 E. I. du Pont de Nemours & Co., Organic Chemicals Dept.**—for the successful industrial development of neoprene, synthetic camphor and of certain other important organic chemicals and dyestuffs.  
**1937 Monsanto Chemical Company**—for developing the large-scale production and utilization of elemental phosphorus.  
**1939 Standard Oil Development Company**—for new chemical engineering processes and equipment to make available super-fuels for

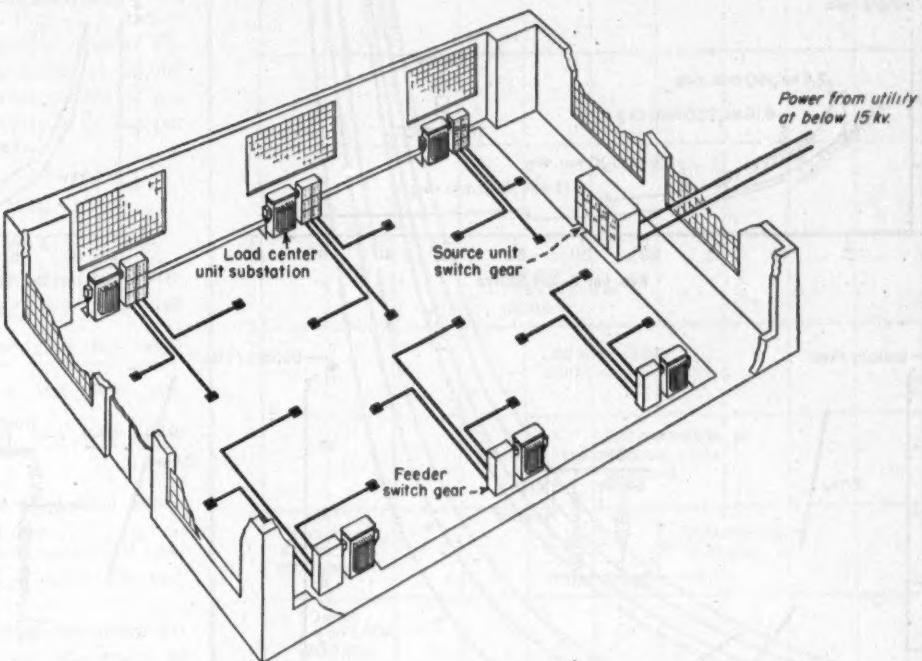
aviation, as well as other valuable products synthesized from the hydrocarbons of petroleum.  
**1941 The Dow Chemical Company**—for the recovery from sea water of magnesium metal sorely needed for aircraft and munitions.  
**1943 American Synthetic Rubber Industry**—67 companies were honored for crowding into 24 months a project that in normal times would have required a dozen years—a miracle of chemical engineering planning and construction.  
**1946 The Atomic Bomb Project, including 122 companies, universities and research organizations**—for contributing as prime contractors so significantly to the research and engineering that were responsible

for this war-ending achievement.  
**1947 Merck & Co.**—for successful pioneering in the large-scale production of streptomycin and other vital medicinals, and, in a broader sense, for distinguished service to humanity.

**1948 Shell Development Company**—for the successful synthesis of glycerine from petroleum for the first time on a commercial scale.

**1949 Celanese Corporation of America**—for the chemical engineering integration of its textile, plastics and chemical operations.

**1951 Phillips Petroleum Company**—for pioneering development of high-abrasion carbon blacks and major contributions to the success of cold rubber.



POWER DISTRIBUTION layout with source unit, load center substation, feeder switchgear and cable showing you . . .

## How to Plan Power Distribution

Only by considering the over-all power system can  
you combine reliability, flexibility and economy in your distribution  
layout. Design facts and costs are offered for your guidance.

**W. B. WILSON**

NOTE: This is the second of two articles on power generation and distribution. The first appeared in the March issue.—EDITOR

**R**ELIABILITY of power supply to various plant utilization areas is the goal of power system design. To achieve this requires linking a reliable source of power supply with an equally dependable plant distribution system.

Various aspects of power generation were covered in *Chem. Eng.*, March 1953, p. 235. Now the subjects of distribution and utilization are analyzed

### Voltage Ratings for Power Equipment

Nominal System Voltage Class	Generator or Transformer No-load Rated Voltage	Utilization Equipment Rated Voltage
240	240	220
480 *	480 *	440 *
600	600	550
2,400 *	2,400 *	2,300 *
4,160 *	4,160 *	4,000 *
6,900	6,900	6,600
13,800 *	13,800 *	13,200 *

\*The voltages marked by an asterisk are the preferred ratings for most applications because of the availability of equipment and over-all sound system engineering.

to round out the industrial power picture.

### Selection of Proper Voltage

System voltages can be divided into two main classes:

1. Main generation and distribution, usually 4,160 v. or 13,800 v.

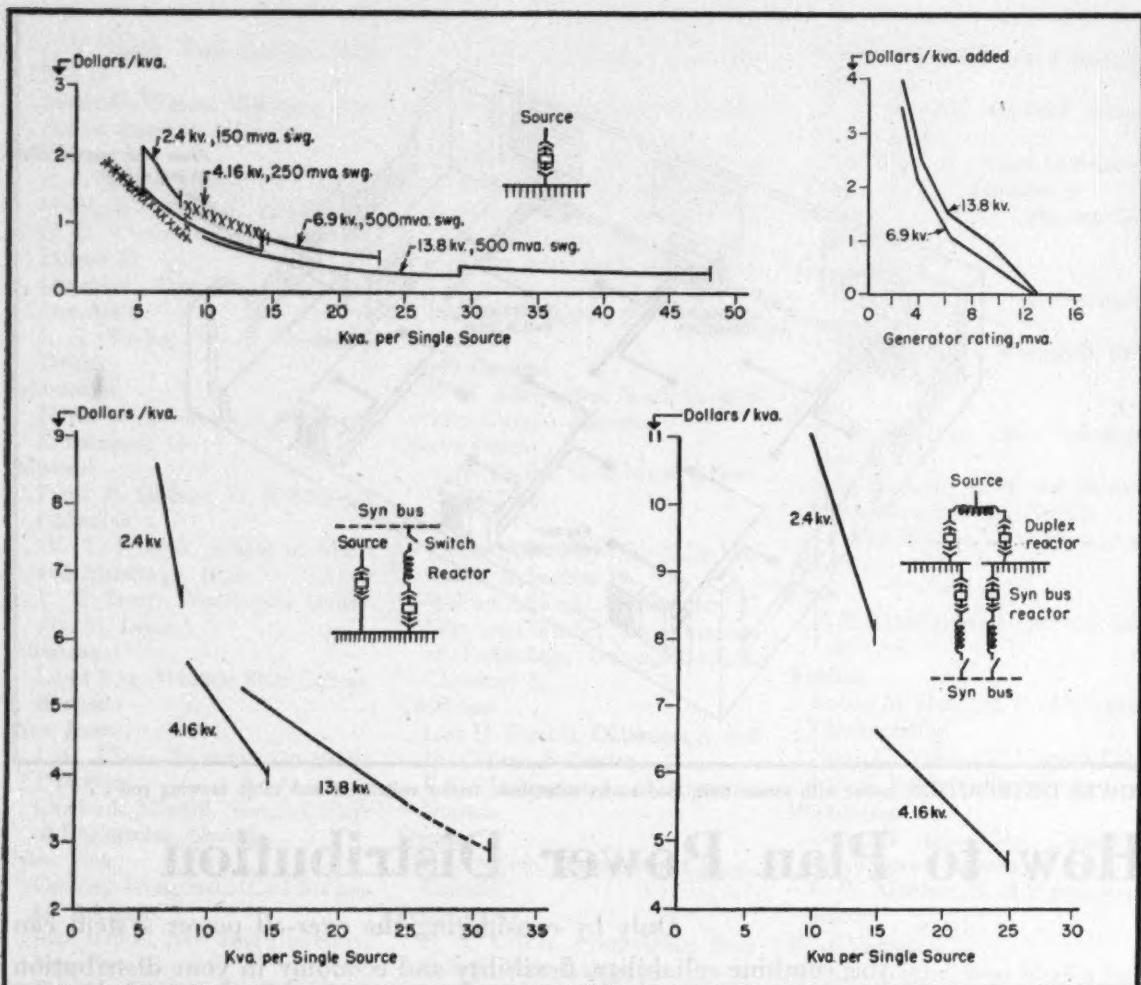
2. Utilization, usually 2,400 v. and/or 480 v.

In order that there be a clear understanding of the term "System Voltage Class", the table shows the voltage ratings for various utilization, generation and distribution equipment.

**Generation and Distribution Voltage**—There is a definite trend towards the selection of 4,160 or 13,800 v. for main plant distribution systems. Some of the very large chemical plant may employ subtransmission voltages above 15,000 v.

A fundamental principle of selecting power system voltage is that, in general, the higher the voltage in a given class, the lower the over-all system cost. The use of 2,400 v. and 6,900 v. for main power distribution is decreasing, primarily because of cost and engineer-

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## 2. DISTRIBUTION SOURCE UNITS, approximate installed cost for three different wiring diagrams.

ing limitations associated with expansion.

Fig. 1 can be used as a guide in the selection of the main plant generation

and/or distribution voltage for new plants. It also shows the extent to which existing 4,160-v. plants can be expanded. If past experience is any guide to future expansion, it will be well to allow for ample electrical growth in selecting the main voltage level and system arrangement.

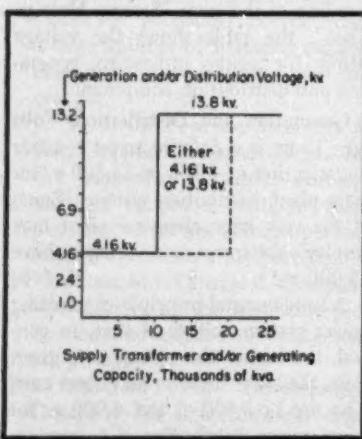
Based on the installed cost of all components comprising the distribution system, a 4,160-v. system has lower first cost than a 13,800-v. system for plants up to about 10,000 kva. For plants in the range of 10,000 to 20,000 kva. capacity, costs of the two systems are comparable. Above 20,000 kva. capacity, a 13,800-v. system is usually preferred.

Increased flexibility, simplicity of operation and provision for future expansion are benefits which result from the selection of higher plant distribution voltages.

The higher cost of 2,400- and 6,900-v. systems as compared to 4,160- and 13,800-v. power distribution systems will be apparent by noting the cost of some of the system components which are plotted on Figs. 2, 3 and 4.

Fig. 2 is a useful series of curves showing the limitations on the amount of power which can be fed from a single source at different voltages, the approximate installed costs of the switchgear (including reactors and synchronizing bus where required) needed for various incoming power supply systems and the additional cost (if any) for turbine-generators rated for operation at voltages above 4,160-v. Transformer costs are not plotted on these curves because their cost is about the same for secondary voltages of 2,400, 4,160 or 13,800 v.

The approximate installed costs of switchgear and cable for different



## 1. LOAD governs distribution voltage.

feeder circuits are shown on Fig. 3 and Fig. 4.

Now for some examples explaining the use of data on Figs. 2, 3, and 4. Assume two plants—one rated at 10,000 kva. and the other at 20,000 kva. The various components of primary distribution costs in dollars per kva. are:

#### Primary Distribution Costs

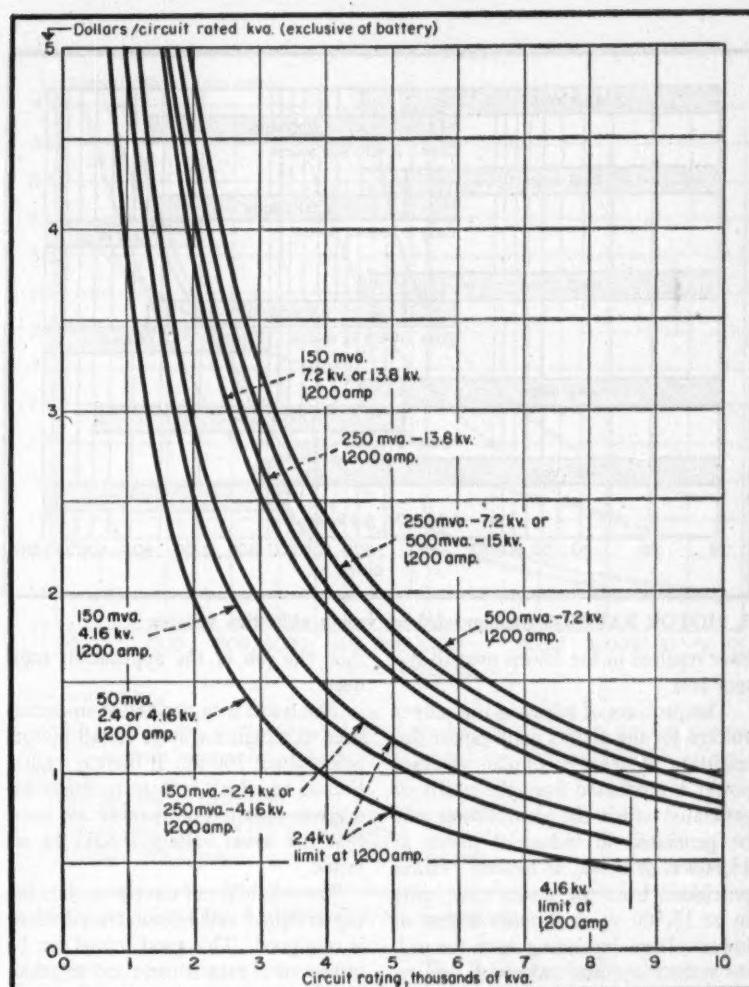
	10,000 kva.	20,000 kva.		
Plant voltage.....	4,160	13,800	4,160	13,800
Source unit (Fig. 2).....	\$1.10	\$0.75	\$2.20*	\$0.40
Primary feeder switchgear (Fig. 3).....	\$1.90*	\$2.70*	\$1.90*	\$2.20*
Primary feeder cable per kva./1,000 ft. (Fig. 4).....	\$2.00*	\$1.60*	\$2.00	\$1.25*
Total primary distribution system.....	\$5.00	\$5.05	\$6.10	\$3.85
Approx. cost 480-v.-permanol load center unit substations.....	\$18.00	\$20.00	\$18.00	\$20.00
Industrial power system cost including 480-v. load center unit substations.....	\$23.00	\$25.05	\$24.10	\$23.85

1. Based on two 10,000 kva. units.
2. Based on 3,000 kva. circuit—250 mva. interrupting capacity.
3. Based on 4,000 kva. circuit—500 mva.

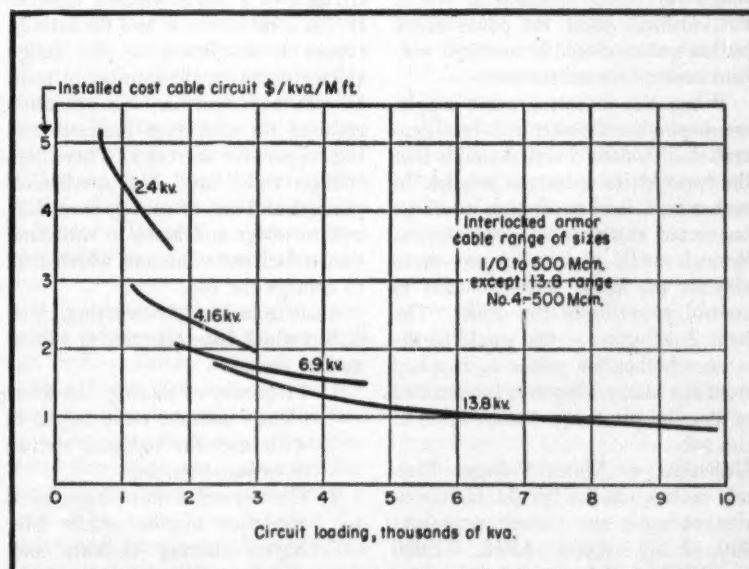
You will note from the above example that, from the standpoint of first cost alone, 4,160 v. would be selected for the 10,000 kva. plant and 13,800 v. for the 20,000 kva. plant. There are a few plants where the load is predominantly large motors (above 250 hp.). In these plants the selection of the primary distribution system voltage might tend to be biased toward a motor utilization voltage.

In the layout of a new plant it is usually best first to consider the selection of system voltage from the standpoint of power distribution only. Too often there is a tendency to compromise between distribution voltage and motor voltage. The result is that the final voltage will be too low from the standpoint of good over-all system design. When this happens, it is often found that the lower voltage distribution system has been justified by operating many motors on the 2,400- or 4,160-v. system that should be on a 480-v. system. More will be said about selection of motor voltages later.

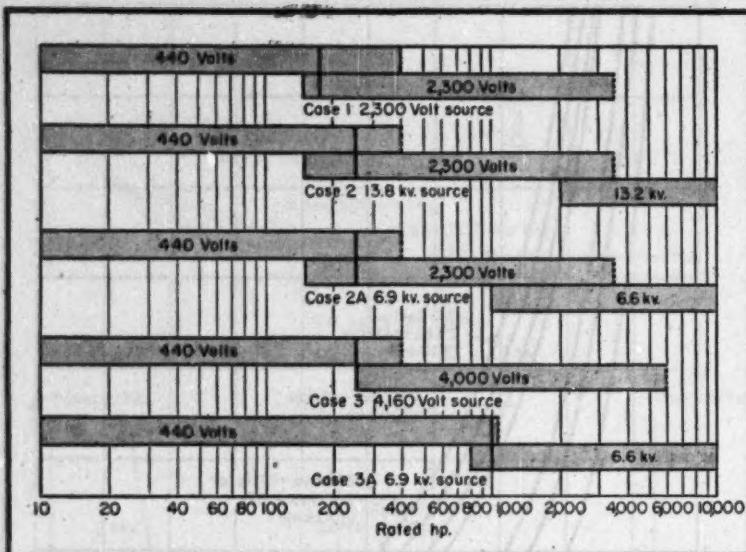
In planning the electrical system don't forget that the plant electrical load will grow. For instance, a 4,160-v. system might be slightly less expensive for a 15,000 kva. plant. If the plant should grow to 25,000 or 30,000 kva., then 13,800 v. would be most economical and provide much greater flexibility in plant operation. In such a case, the selection of 13,800 v. instead of 4,160 v. certainly would



3. PRIMARY FEEDER switchgear, approximate installed cost.



4. PRIMARY FEEDER cable, approximate installed cost.



##### 5. MOTOR RATINGS recommended for various utilization voltages.

have resulted in the lowest over-all system cost.

The problem of selecting the proper voltage for the plant's main power distribution system is similar whether power is purchased from the utility or generated within the plant. Power may be generated in industrial plants at 13,800 v. or below, as desired. Power purchased from the utility may come in at 13,800 v. or at some higher or lower voltage depending upon the utility system and the industrial load requirements.

When power supplied from the utility is at the voltage below 15 kv. best suited for power distribution within the industrial plant, the power distribution system should be arranged with load center unit substations.

When the industrial plant supplements purchased power with local generation, it is usually very desirable that the two systems operate in parallel. In such a case, local generation would be connected to the plant power system through metal clad switchgear—probably in the same "line-up" used to control power from the utility. The basic distribution system would be the same whether all power is supplied from the utility, all power is generated within the plant or a combination of the two.

**Utilization or Motor Voltages**—Electric motors can be bought for operation at most any voltage required—440, 2,300, 4,000, 6,600, 11,000 or 13,200 v. Selection of the proper voltage for a specific application is

then the job of the application engineer.

The trend is to use 480 v. in preference to a higher voltage for all motors below about 200 hp. If there is a question as to which voltage to select for a given motor, the chances are good that the lower voltage should be selected.

The reliability of electric motors being designed and manufactured today is very good. This good record can be improved if care is exercised to select the best motor voltage for each job.

The voltage selected will affect the winding strength in small motors. The strength of a stator winding depends on the conductor size and the ratio of copper to insulation; as the design voltage increases, the number of turns in each coil increases, the insulation required for each turn increases and the copper size decreases. These high voltage coils have less mechanical strength and are, of course, more difficult to wedge and brace to withstand the stresses and vibrations which tend to damage the coil.

Aside from horsepower rating, other factors which favor selection of a lower voltage include:

1. Frequency of starting—the lower voltage coils are more rugged to withstand the repeated stresses of frequent starting.
2. High speed motors—high speed induction motors usually have higher starting currents and, therefore, higher stress on the winding than low speed motors.

The charts in Fig. 5 indicate the general range of motor horsepower ratings that should be considered for various voltages. Near the ends of the range for each voltage class, the application should be carefully reviewed to be sure that other factors such as starting equipment, speed, type of motor, etc. do not influence voltage selection enough to make a different voltage more desirable for a specific application.

The heavy vertical lines for each system denote the rating where initial system cost is the same for two different motor voltages. The approximate costs of motors, controls and substations vs. motor horsepower are plotted on Fig. 6.

**Load-Center Distribution**—The trend in the chemical industry, as in all other industries, is to use the load-center system of power distribution.

Whether it is a new plant, expansion of an existing plant or simply the rearrangement of equipment for greater production, the load center system of power distribution is the most flexible way to supply existing loads or to meet changing load demands at lowest investment. A unit substation may supply power to load centers at 13,800, 4,160, 2,400 v., or other voltages.

The fundamental approach is to use a relatively high voltage for transmitting power to the load centers where it is stepped down to utilization voltage. The primary voltage varies as a function of total plant load and the secondary voltage as a function of motor size.

For the few very large plants where voltages above 15 kv. are used for transmission to the various plant areas, or where power is supplied by the utility at a higher voltage, master unit substations can be strategically located at various load areas within the plant.

The load-center system has been well described elsewhere and will not be discussed in detail here. The major advantages of the load center system of power distribution are:

1. Lower first cost.
2. Less voltage drop—better performance of lights, motors, and other utilization equipment.
3. Reduced engineering and planning.
4. Simplified purchasing.
5. Easier to finance expansion.
6. Easier to install electrical equipment.

7. High salvage value of equipment.
8. Greater flexibility.

### Power System Grounding

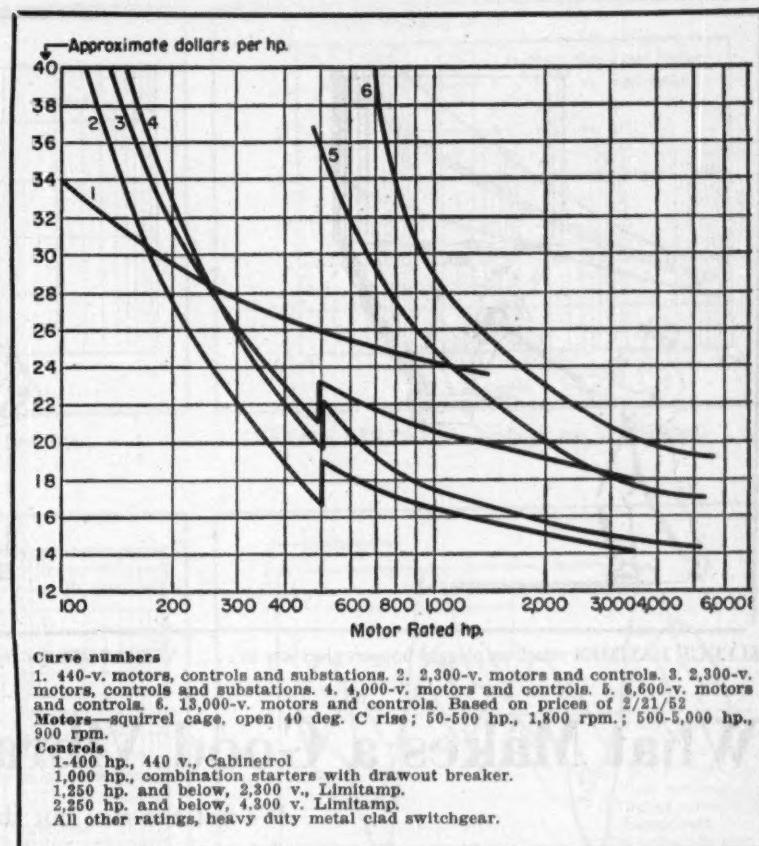
A grounded power system is a system of conductors in which at least one conductor or point is intentionally grounded, either solidly or through a current limiting device. The point of grounding is usually the neutral point of transformer or generator windings.

The trend in the chemical industry, as in other industries, is the adoption of grounding for systems at all voltage levels. The main advantages to be gained from effectively grounding the power system result from the elimination of transient overvoltages which often occur on ungrounded systems. Practically 100 percent of the 4,160 and 13,800 v. systems are operated as grounded systems. Last year almost 50 percent of the 480 v. load center substations purchased from the General Electric Co. had the transformer neutral available for system grounding. **Operating Experience**—Plant experience of several years with large and small plants has shown that there are no more outages with grounded neutral than with ungrounded systems, but that the down time while faults are being located is far greater for the ungrounded system. Grounded neutral systems have proven to be more reliable by a substantial margin.

It has been the experience of operators who have used both grounded and ungrounded neutral systems that the failure rate is substantially lower and the time the system is out of service is less on the grounded system. This results from the fact that transient overvoltages are greatly reduced on a grounded neutral system. Because grounding reduces these overvoltages, the life of electric insulation will be increased and service interruptions will be minimized. Even though the overvoltages of an ungrounded neutral system may not be high enough to cause multiple failures every time a ground fault occurs, the repeated application of these overvoltages will weaken the insulation and cause a higher failure rate than in a grounded neutral system where the overvoltages are greatly reduced.

### Short Circuit Protective Devices

There is an increasing awareness, on the part of plant management as well



### 6. MOTORS, CONTROLS, SUBSTATIONS, approximate cost.

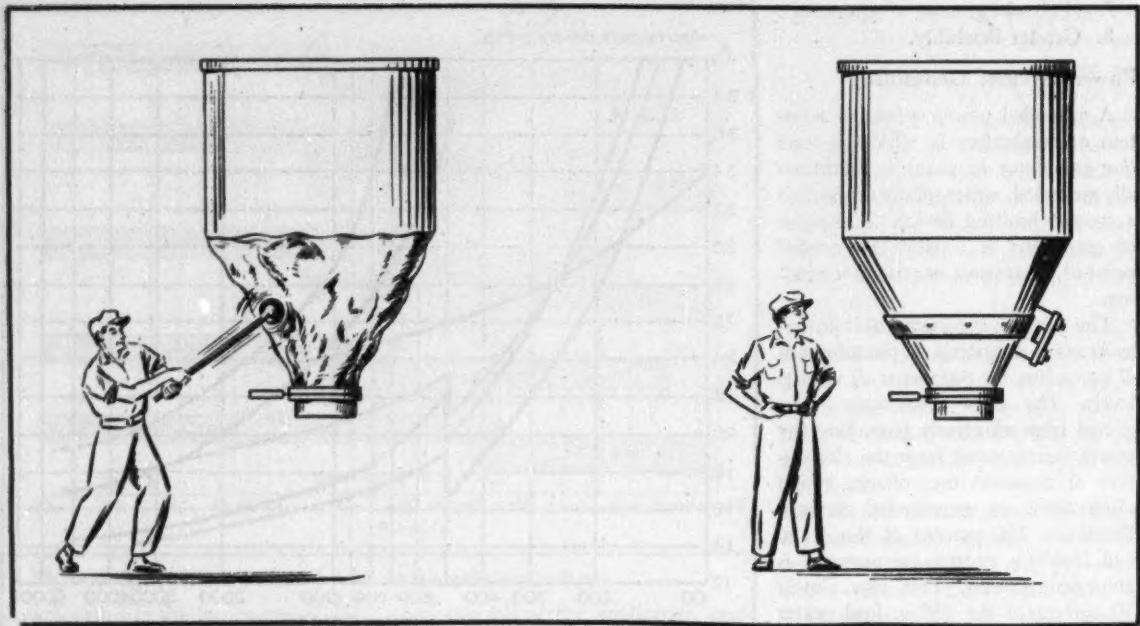
as engineers, of the importance of adequate short-circuit protective devices. When short-circuit protective equipment and switching devices are purchased, the purchaser is paying for equipment that is intended to operate successfully when called on to clear a short circuit. That may be only a few times during the life of the protective device. If, however, the device does fail to operate those few times because it is inadequate, then the investment in that short-circuit protective device is wasted. Damage to other plant equipment may far exceed the price paid.

It is important that adequate protection be provided for the low voltage, medium voltage and high voltage systems alike. For instance, in one plant the branch-circuit fuse (the fuse in the circuit to the motor) which protected this circuit was inadequate and consequently blew up and caused a fault. The main fuses between the source and branch-circuit fuse failed because they were too small. The main breaker also failed.

The fault was finally cleared when the power company's circuit breaker tripped open. In this case the loss of production of the entire plant was caused by a fault that could have been confined to one small motor circuit. This shows how inadequate short-circuit devices are a hazard to continuity of production.

Electrical manufacturers have invested millions of dollars in short-circuit testing stations. They have spent other millions of dollars in testing thousands of designs in circuit protective equipment. These equipments are often tested at currents above their rating and often to destruction.

This gives the design engineer a background of experience in the effects of short-circuit failures that is more comprehensive than can be obtained in any other way. It is felt that it is good engineering judgment to use the engineering background of tests of this kind in evaluating what can happen to the protective equipment in a plant should a major short circuit occur.



**SELDGE HAMMER** attack on plugged hoppers gives way to . . . **VIBRATORS** for free material flow when you know . . .

## What Makes a Good Vibrator Set-up?

It's not the size but the way you use vibrators that makes them effective in keeping hopper outlets open. Proper analysis of each application gives long life and trouble-free operation.

### FREDERICK MARICH

In show business on Broadway there is an old saying that the show must go on regardless of any personal tragedies that may befall the cast. Individual problems are always surmounted to keep the show going.

Undoubtedly some of the same spirit must prevail among production men in the chemical and allied industries. A production worker hammering away with bars, hammers and pipe wrenches at the hopper of a spray dryer or cyclone exemplifies the motto: "Production must go on at all costs." Plant management, condoning such practice, realizes that any shut-down would be far more costly.

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Yet reliance on brute strength and awkwardness is a poor substitute for engineering know-how to keep materials flowing. Properly engineered vibrator installations can open bottlenecks, eliminating headaches both for operators and management while lowering operating expense.

### WHY INDIVIDUAL ANALYSIS?

Some of the more difficult vibrator applications are found in the fine chemical and food industries in connection with spray drying and dust collecting. Variations in the design and size of spray dryers, cyclones and hoppers necessitates careful engineering of the individual vibrator applications to keep material moving continuously and do so without creating fatigue cracks in the metal.

At first glance the problem of moving materials such as detergents, fine chemicals and spray-dried food products in a hopper with a minimum

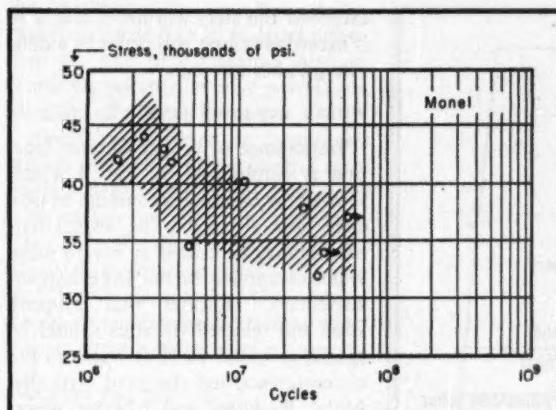
slope of 60 deg. seems rather simple. After all these materials are relatively lightweight and subject to motion in a spray dryer or cyclone. Despite this, numerous difficulties are encountered.

Faced with a situation where solids are plugging a hopper outlet a person's first impulse is to get a vibrator strong enough to shake heavily the plugged chamber. This practice is even encouraged by vibrator manufacturers when they recommend units with 20 percent excess power.

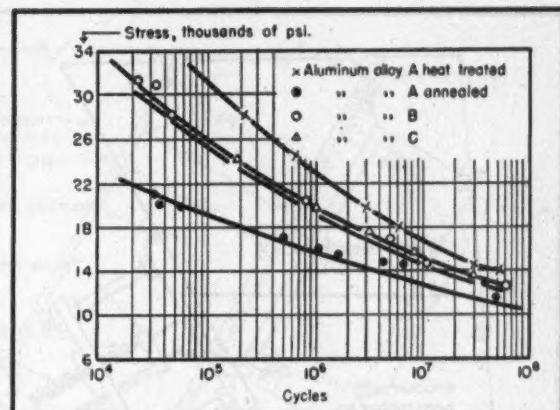
While installation of a heavy vibrator may be all right as a general recommendation the plant manager needs to know more than that to arrive at a satisfactory solution of the problem. Only by requiring an individual analysis by an experienced engineer will he get the answer he is seeking.

### STATIC CHARGES CLOSE BOTTLENECK

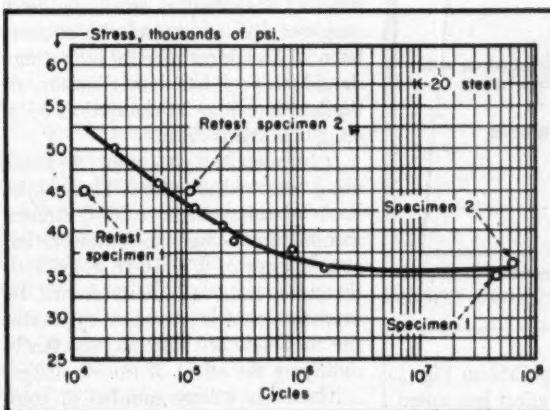
Careful analysis has shown static electricity to be a major source of trou-



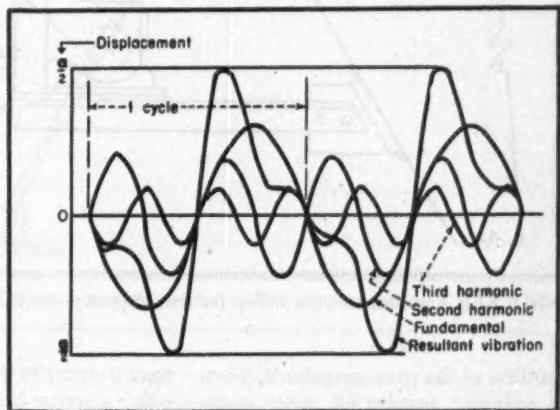
1. ENDURANCE LIMITS scatter where flaws exist.



2. CERTAIN FAILURE of aluminum can be predicted.



3. INFINITE ENDURANCE of stainless can be assured.



4. PROPER LOCATION of units avoids peak stresses.

ble in making vibrators work effectively on the materials previously mentioned. The action of the vibrator attracts the positively charged particles to the negatively charged hopper and packs them down tighter as they accumulate. Since most of these materials are hygroscopic they absorb moisture from the steam laden air with the result that the bottleneck becomes pretty well sealed off.

In cases of this nature the 20 percent excess power of a vibrator would only aggravate packing and in many instances create fatigue cracks in the hopper.

In contrast to static elimination in textile printing the problem here is relatively simple. Wherever an electric or air vibrator is used the hopper should be grounded with thin strands of copper wire soldered at not more than three foot intervals and then grounded to the nearest girder. It is not sufficient that such hoppers are already grounded at their supports.

Static electricity is fickle and must be grounded as near its source and as often as possible.

#### AVOID FATIGUE FAILURES

Prevention of fatigue cracks in hoppers being vibrated rests on correct sizing of the vibrators, proper location and mounting. Calculation of stresses in hoppers is a complicated and inexact procedure, at best. However, with some experience and the data available in the literature a general approximation can be made for the correct application of vibrators to hoppers of cyclones, spray dryers and other similar equipment.

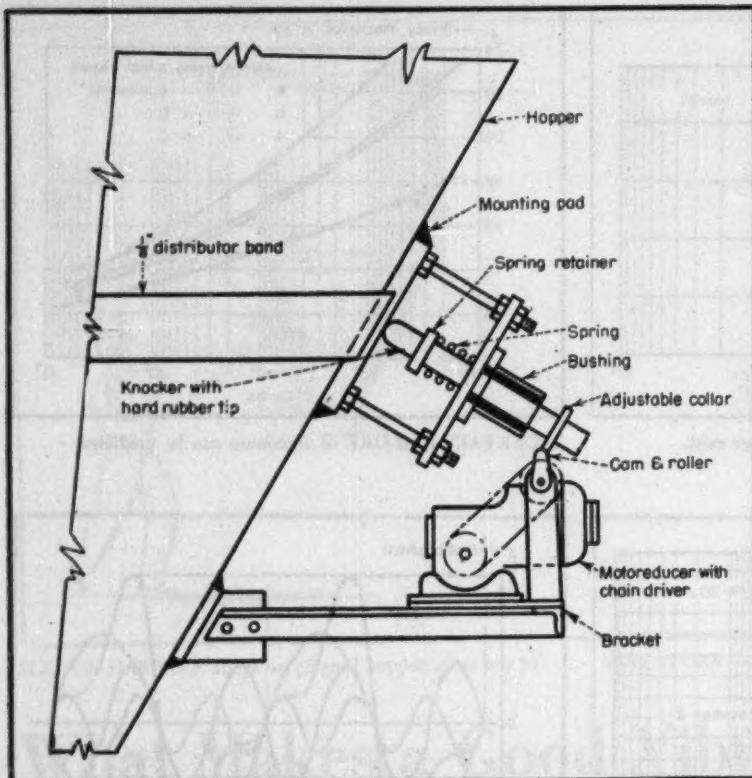
It must be noted here that such equipment is more or less empty compared to storage bins which are normally full. Thus the problem is one of moving material clinging to the sides rather than the movement of a large mass of material.

In applying vibrators to hoppers the

aim is to provide vibration of maximum amplitude without overstressing the metal in the hoppers. As a starting point the stress and endurance limits of various metals are shown by a group of curves.

A scatter band from an endurance test<sup>1</sup> on one lot of monel metal is shown in Fig. 1. The scatter band of endurance limit points is due to inhomogeneities or surface flaws in the specimens. The upper boundary represents what a material might do if flaws and inhomogeneities were avoided. The lower boundary represents the actual endurance of the test metal under various stresses when such flaws are present.

Endurance life curves<sup>2</sup> for aluminum alloys sometimes used in cyclones and hoppers are shown in Fig. 2. These curves illustrate that there is no definite stress below which an infinite number of stress cycles can be borne. Such material will be sure to fail, re-



**KNOCKER** simulates hammer wallop for low frequency vibration.

gardless of the stress magnitude, when a sufficient number of stress cycles have been applied.

Tests<sup>a</sup> on an unusually homogeneous stainless steel specimen are shown in Fig. 3. The points for the higher stresses lie upon the curve much more regularly than usual when so many points are determined. This is in dis-

tinct contrast to the points on Fig. 1, where a scatter band effect was noted.

Difference in strength-endurance characteristics for aluminum and steel is shown by a pronounced change in the slope of the steel curve. In this region or "knee" of the curve a small decrease in stress results in greatly increased life.

Points are shown for repeat tests on two specimens. One of these specimens was damaged during the first test series so that it failed sooner on the second test than did a virgin test piece. The other specimen was undamaged by the initial test and actually outlasted a virgin piece on the second test.

Stainless steel, then, has a definite endurance limit which aluminum and most other non-ferrous materials are lacking. If the endurance limit is not

exceeded the steel will never fail; if it is exceeded failure will occur in a definite number of cycles.

#### WHERE AND HOW MANY?

Importance of proper vibrator location is emphasized by Fig. 4 which shows how harmonics combine to produce peak stresses<sup>4</sup>. The several harmonics may be caused by one or more vibrators applied to the same hopper. Experience indicates that properly sized and selected vibrators should be spaced at least 6 to 10 ft. apart on the circumference and staggered vertically. Metal thickness and vibrator power will influence final decision on spacing.

In large diameter spray dryers, it is preferable to have a large number of smaller sized vibrators distributed in a staggered fashion around the circumference. Also, more vibrator mountings should be provided than vibrators, so the locations may be changed as operating conditions dictate.

It is generally a good policy to avoid using oversized vibrators. These units tend to cause excessive local stresses without producing sufficient vibration at a distance of 6 to 10 ft. away. Furthermore, static electricity caused by oversized electric vibrators aggravates the hold-up of material practically nullifying the effect of the vibrations.

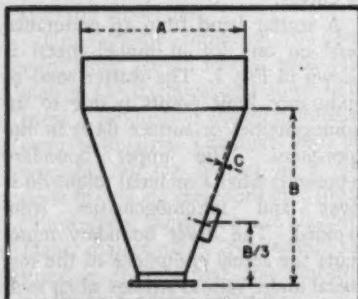
There are a large number of commercial electric vibrator sizes available. The designer, therefore, has flexibility in making the correct selection for a given job.

#### FAULTY DESIGN IS CORRECTED

At times it is desirable to construct conical bins wherein an inner cone is surrounded by an outer bin. A hypothetical case has been illustrated to show the incorrect application of electric vibrators on this type of bin.

Both inner cone and outer skirt are being vibrated by an oversized vibrator. The 1½-in. tube welded to the inner cone could easily poke a hole through the relatively thin sheet. And on the outer skirt excessive strain will likely develop because a heavy ¼-in. mounting plate has been welded to the relatively light skirt.

A remedy for this situation is also depicted. The inner cone has been reinforced by a tack-welded vibration-distribution band. The outer skirt has been reinforced in similar fashion and a ½-in. mounting plate substituted for the ¼-in. plate. Further improvement



Hopper Dimensions Govern Vibrator Size

Hopper Size ft.	B, ft.	C, in.	Electric Vibrators		Air Vibrators		Mechanical Knockers	
			Watts	Cycles per min.	cfm. at 80 psi.	Cycles per min.	hp.	Strokes per min.
3.0	2.33	1/16	45	3,600	1.5	5,300	1/20	15-30
4.0	3.0	1/8	75	3,600	2.0	4,900	1/12	15-30
5.0	3.75	5/16	120	3,600	2.5	4,700	1/4	30-60
6.0	4.75	1/4	275	3,600	3.0	4,000	1/4	30-60
7.0	5.33	5/8	600	3,600	3.5	3,600	1/3	30-60
8.0	6.25	1/2	1,000	3,600	4.0	3,600	1/3	30-60

can be obtained by using two smaller vibrators spaced 8 to 10 ft. apart rather than the one large vibrator. And of course the installation must provide for bleeding off static electricity.

Air-driven vibrators are sometimes used in preference to the electric type where widely-spaced intermittent operation makes low first cost attractive. They have the disadvantage of being noisy and are more expensive to operate. Amplitude adjustment is not as readily attained as in the electric type without greatly reducing effectiveness.

#### KNOCKERS TOO ARE USEFUL

Sometimes there are jobs where neither electric nor air vibrators will keep material moving. Then it may be necessary to use a mechanical knocker as shown in the sketch. This unit has a motor reducer with chain drive, cam and roller which actuate a spring-return piston having a hard rubber tip. The low-frequency hard kick which is produced simulates the wallop of a manually operated sledge hammer.

On knocker installations the size of the spring and motor can be varied to produce exactly the desired force and frequency of blow. Flexibility in this respect is considerably greater than can be secured with electric or air vibrators. However, the first cost and maintenance of mechanical knockers will be higher. This relegates their use to special applications.

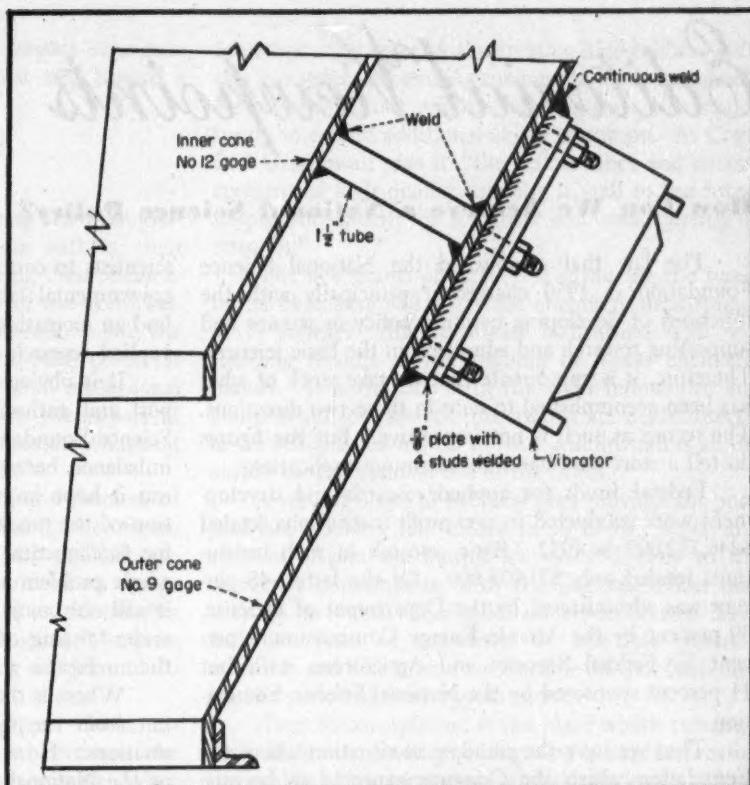
#### ROUGH GUIDE FOR SIZING

Proper teaming of vibrator and bin sizes are given in the table, p. 206. Electric and air vibrator sizes are approximate equivalents of various manufacturers' recommendations. The mechanical knockers are approximate equivalents for the special situations that may justify their use.

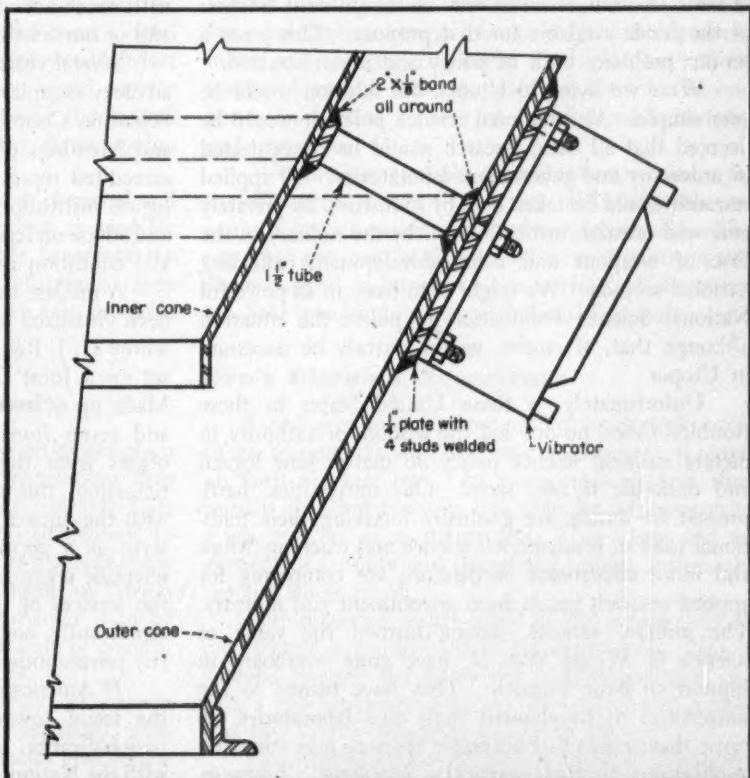
None of these recommendations can be taken literally, nor would any vibrator manufacturer make such blanket proposals. Individual installations contain too many variables to permit proceeding on this basis. Instead the tabular information can be used as a guide for individual problems.

#### REFERENCES

1. National Advisory Committee for Aeronautics, Russell and Welker, "Prevention of Fatigue in Metals," p. 46.
2. Proceedings American Society for Testing Materials, Johnson and Oberg, Vol. 29, Part 2, (1929), p. 839-852.
3. National Advisory Committee for Aeronautics, Technical Note 381 (1931).
4. H. H. Bruderlein, Aviation Vol. 39, Jan. 1940, p. 40, 41.



FAULTY DESIGN of vibrator mounting will crack bin surfaces.



CORRECT DESIGN distributes the load ensuring long trouble-free operation.

# *Editorial Viewpoints*

## **How Can We Achieve a National Science Policy?**

The law that established the National Science Foundation in 1950 charged it principally with the functions of developing national policy in science and supporting research and education in the basic sciences. Therefore, it is appropriate that we take stock of what has been accomplished to date in these two directions. The record as such is not impressive. But the figures do tell a story that has truly alarming implications.

Federal funds for applied research and development work conducted in non-profit institutions totaled \$246,532,000 in 1952. Basic research in such institutions totaled only \$71,078,000. Of the latter, 48 percent was administered by the Department of Defense, 39 percent by the Atomic Energy Commission, 9 percent by Federal Security and Agriculture, with but 1½ percent sponsored by the National Science Foundation.

Thus we have the paradoxical situation where the Foundation which the Congress expected to become the principal agency of the government for the support of basic research, received only an insignificant fraction of the funds available for that purpose. This poses a serious problem, both of policy and administration.

Were we living in Utopia, the solution would be very simple. As a national science policy it would be decreed that all basic research would be concentrated in university and government laboratories. All applied research would be taken over by industries, by privately endowed research institutions, or by the military in the case of weapons and other developments affecting national security. We might even have an all-powerful National Science Foundation to police the situation although that, of course, would scarcely be necessary in Utopia.

Unfortunately in these United States in these troubled times, no one has the wisdom or authority to dictate national science policy no matter how logical and desirable it may seem. Our universities, hard-pressed for funds, are gradually forsaking their traditional roles in fundamental science and teaching. More and more educational institutions are competing for applied research grants from government and industry. The military services, having learned the value of science in World War II, have gone overboard in support of basic research. They have turned to the universities to supplement their own laboratories because they realize that academic research may stimulate applications to their particular problems. Likewise, these grants serve to attract and encourage university

scientists to continue their careers in military or other governmental laboratories. So it is not surprising to find an increasingly large proportion of both basic and applied research dictated by federal funds.

It is obvious that without a great deal more support and authority from the Congress, the National Science Foundation can do little to correct the present imbalance between basic and applied research. Nor can it hope immediately to take over the administration of the much larger funds spent by other agencies for fundamental research. The real solution to this whole problem seems to lie with the Congress. And it will not come until its leaders obtain a much better understanding of science and research, particularly in their relations to national policy.

Where is that education to come from? Certainly not from the agencies competing for federal appropriations. How about the National Research Council or the National Academy of Science? With all due respect for these venerable bodies, we prefer to see a little more active participation on the part of industry and of our scientific and engineering societies.

Several years ago Great Britain set up an informal advisory organization known as the Parliamentary and Scientific Committee. In this Committee 175 Peers and Members of Parliament regularly meet with the accredited representatives of 74 scientific and technological institutions. Their common purpose is to study and advise on legislation affecting the advance of science and education in the British Empire.

A modest move in this same general direction has been visualized by Congressman Hinshaw of California whose H. J. Res. 166 introduced on February 3 would set up a Joint Congressional Committee on Science. Made up of seven appointed members of the Senate and seven from the House of Representatives, plus others from the Congress who volunteer their participation, this group would be concerned primarily with the impact of science on public affairs. It would serve as a permanent liaison between Congress and scientific organizations. It would meet with and utilize the services of the National Science Foundation and, significantly, could "accept the voluntary assistance of any private individual or organization."

If American industry is seriously concerned with the trend toward governmental domination, if not nationalization of research, it is high time we joined with the National Science Foundation and the Congress in the all-important task of promoting "a better under-

standing of the actual and potential impact of science upon public affairs." That is the first step toward a sound national policy in science.

### An Ominous Trend

There is an increasing trend among scientific journals toward the use of subsidies from authors, their companies or the institutions sponsoring their research. This unfortunate plight is the result of the skyrocketing volume of original scientific publications and the even more startling increase in publishing costs. It affects most directly the scientific and professional societies that are obligated to publish the papers of their members irrespective of their immediate interest or value to the readers of the journals.

A recent survey of the operations and finances of scientific journals made by the National Science Foundation covered more than a hundred such publications. Of these, 16 require payment of a publication charge from the author or his institution based on the number of pages printed. An additional 11 journals require payment for excess pages on very long articles and 26 require payment for plates and tables.

Although the total for such charges seldom exceeded an eighth of the journal's total revenues, the trend is nevertheless unfortunate in our opinion. Were it carried to any very great extent, it might seriously threaten the character and integrity of all scientific and technical publications. Despite the most careful and critical reviews, the editorial content would reflect the work and views of only those who could pay for the privilege of publication. Thus would the journal tend to defeat its own purpose in the dissemination of worthwhile scientific information.

Fortunately for the readers of most chemical and engineering publications, there is no place or need for such subsidies. They are edited for the benefit of the user rather than the producer of the information they publish. Their editorial pages are not for sale, in whole or in part.

### Where It'll Do the Most Good

No group within the chemical industries has given more serious study to university-industry relations than has the management of the Du Pont company. Its long-time program of grants-in-aid and fellowships to encourage fundamental research and post-graduate study has been widely hailed as a prudent means of "stock-piling" basic knowledge. Now that program is to be extended to assist and advance the teaching of chemistry in American colleges and universities.

These new plans are the result of almost a year's discussions between educators and industrialists, with helpful advice from governmental agencies and educational foundations. Simultaneously a survey was made of approximately fifty institutions that in the past have

been especially successful in training high-caliber graduates in science and sending them on to graduate schools. Here the Du Pont officials felt was their best opportunity to extend additional aid to education. As Crawford Greenewalt puts it: "the maintenance and encouragement of high quality teaching is vital to the future supply and quality of scientists and consequently of research."

The new grants of \$2,500 for advancing the teaching of chemistry will go to the chemistry departments of 19 colleges. All are private institutions with outstanding records in the training of 4-year chemistry majors. As is the case with the older fellowships and grants-in-aid for research, the awards are made directly to the schools, leaving up to their administrators all decisions on the detailed use of the funds.

A second phase of the new plan provides for post-graduate teaching fellowships in 13 of the larger universities. Again the awards are made directly to the chemistry departments, with the one restriction that they go to outstanding graduate students who have had two years of experience as half-time teaching assistants and who intend to continue on that basis during the period of their appointments.

Here, in our opinion, is the place where comparatively little money can go a long ways toward improving the quality of teaching at the elementary levels. There is altogether too much turn-over among graduate assistants who have had little or no experience in teaching — yet are in a key position to guide and inspire our future scientists and engineers. The new plan will encourage some of these graduate students to become better teachers as a result of accumulated knowledge and experience.

We continue to applaud Du Pont management for its willingness to invest more than \$500,000 each year in the aid of education and fundamental research. The new plan puts part of that money to work where it will do most good in improving the teaching of chemistry. No field is more deserving of industrial support.

### Don't Discount Experience

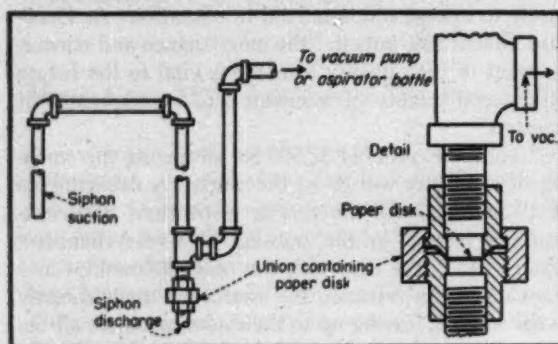
Good men in their most productive periods sometimes become available for new employment through no fault of their own. As prospective workers they usually need less training, less time for adjustment to a job, and less close supervision. They often add an element of stability and thoughtful influence throughout the whole plant.

Glib executive orders never to hire a man over 40 can deprive a company of these advantages. This is wasteful because the assets the middle-aged man can offer a new employer often far outweigh the disadvantage of a shorter remaining period of service.

Experienced employees are too scarce to be wasted. Quietly but surely, arbitrary age limits on hiring and retiring are becoming obsolete.

# The Plant Notebook

Edited by Theodore R. Olive



## Paper Diaphragm Starts Siphon For Corrosive Liquids

RENZO VOLTERRA, Refinery Superintendent, General Plate Div., Metals & Controls Corp., Attleboro, Mass.

### ★ January Contest Prize Winner

Shown above is a design for a semi-automatic siphon which solved a problem of long standing in our precious metals refinery. It seems likely that it can be used equally effectively in many other applications.

In the precious metals refining industry one of the processes used in separating gold from silver consists in the attack of the metal or of the sludge by concentrated sulfuric acid. The silver is dissolved as sulfate and the gold (with the platinum metals) remains as a residue.

The solution has to be transferred hot, at around 300 deg. C., and a siphon is generally used. In order to operate as automatically as possible, the siphon illustrated by the sketch has been adopted.

At the delivery end of the siphon a tee and a union are connected as near as possible to each other. After the union, a length of straight tube is attached, as long as convenient. The union is a few inches lower than the end of the inlet branch of the siphon. At the lateral branch of the tee, an appropriate length of pipe is connected for vacuum attachment. Before using the siphon, the union is opened and a disk of paper is inserted between the two pieces. The union is then closed tight.

### ★ February Contest Prize Winner

"New Instrument Measures Oxygen in Steam at Very Low Concentrations."

A prize of \$50 in cash will be awarded to Frederick Fahnoe, chemical engineer, Vitro Corp., New York 7, N. Y. Mr. Fahnoe's article will appear in the Plant Notebook section of our May issue.

**\$50 PRIZE FOR A GOOD IDEA**—Until further notice the Editors of Chemical Engineering will award \$50 cash each

month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

**\$100 ANNUAL PRIZE**—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional \$100 prize.

**HOW TO ENTER CONTEST**—Any reader of Chemical Engineering, other than

a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Articles which are acceptable but are not winners will be published at regular space rates (\$10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y.

The siphon is immersed in the liquid and vacuum applied to the lateral branch. The corrosive solution rises into the siphon, reaches the tee and the union. Before the solution has time to flow very far into the lateral branch, the paper is burned and the siphon starts.

The operation can be controlled by a man who is far away from the unit. If desired an aspirator bottle can be inserted in the lateral branch between the tee and the pump, for safety and control.

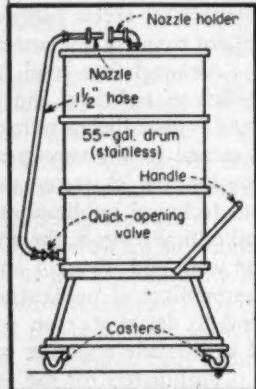
The siphon has been used very satisfactorily in the refining operation described. In other uses it might be necessary to change diaphragm material in order to adapt it to particular physical and chemical conditions.

## First-Aid Devices Protect Alkali-Metal Workers

PAUL C. ZIEMKE, Safety Engineer, Oak Ridge, Tenn.

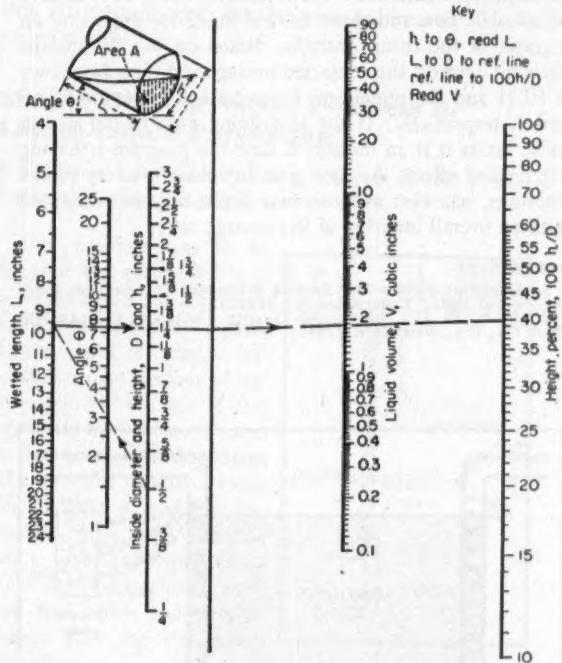
Alkali metals are likely to be bad actors, especially from a safety standpoint. This is particularly true of sodium-potassium alloys which are liquid at room temperature and react violently with a minimum of moisture in air.

When a spraying leak occurs, especially under high temperature and pressure, things happen fast and the best of special extinguishing agents and special fire-fighting clothing must be on hand. In addition, there is the problem of first aid for any worker unlucky enough to have been hit by the spray. Such metals are quite destructive to human tissues. The force of the spray and the inevitable reaction with body fluids causes deep-seated burns that are extremely difficult to heal. It is imperative for first aid that the metal be scraped off and the victim laved immediately with quenching liquid. For this purpose we use a mineral oil of suitable characteristics.



Originally this mineral oil was stored in 5-gal. safety cans and kept in the first aid cabinet. We have now developed a much better system as illustrated in the accompanying sketch. The oil is transported to the scene of the accident in a 55-gal. stainless steel drum supported on a welded steel frame mounted on casters and provided with a handle for pushing. The drum is provided with a hose, shut-off valve, and nozzle for applying the oil, the latter ordinarily inserted in a fitting at the top of the drum, and secured to it by a seal wire to prevent tampering. The arrangement is clearly shown in the drawing.

This gives us an ample supply of oil with which we can douse the injured person from head to foot. Then, if the medical authority desires, we can transport the casualty to the hospital in a special liquid-tight ambulance cart which we use as piece of companion equipment. The cart is an aluminum tub on a tubular aluminum frame, mounted on casters. The tub is about 6½ ft. long, 2½ ft. wide and 6 in. deep, of one-piece construction.



### Nomograph Gives Liquid Volume Within a Slanting Tube

JACK LOWE, Servel, Inc., Evanston, Ind.

The volume of liquid held in a slanting tube of outside diameter  $D$ , by a plane obstruction of height  $h$  perpendicular to the tube wall, can be found by the formula  $V = [(2/3)(hD - h^2)^{3/2} + (h - D/2)A]L/h$ , where  $L = h \cot \theta$ , and  $A$ , the area of wetted segment of the obstruction, equals  $(4/3)h^2 \sqrt{D/h - 0.608}$  if  $h$  is less than  $D/2$ ; or  $A = \pi D^2/4 - (4/3)(D - h)\sqrt{D/(D - h)} - 0.608$  if  $h$  is between  $D/2$  and  $D$ . Here  $L$  is the distance the liquid backs up the tube when its angle is  $\theta$  deg. with the horizontal.

The formula can be used to make a nomograph, construction of which is described here so that similar nomographs for tube volume can be constructed for ranges not covered by the variables used here. Then too, in similar problems where certain variables are so tied up that they cannot be put in logarithmic form for orthodox nomograph construction, the same approach might be used.

A brief examination of the formula shows that at least four scales will be needed; one for each of the variables and also a reference line. Scales for  $V$  and  $L$  (and perhaps others) will be logarithmic. The rest of the formula including the segment area will be some function of  $h$  and  $D$ . The scale direction, whether up or down, is determined by a logical examination of each variable's effect in the formula.

#### HOW TO DRAW CHART

To start, three parallel lines are drawn and the outer two are marked off in logarithmic scales to cover the desired ranges for  $L$  and  $V$ . The maximum value for  $V$  can be found from the formula by substituting values for the maximum diameter, height (which will be the same as  $D$  when the tube is completely blocked), and length.

It is assumed that the  $D$  scale will fall somewhere between the  $L$  and reference lines, and be parallel to them. Although the moduli and the distances between the various scales will be predetermined by the arbitrary selections made in constructing the three scales, it is not necessary to know any moduli or distances using this method of nomograph construction. A construction line which is horizontal, or nearly so, is drawn from a point, say 10, on the  $L$  scale to the reference line. Some convenient value of  $D$  is chosen (1 for example) and by definition can be made to fall somewhere on this construction line from point  $L = 10$  to the reference line. Now, with given values of  $L = 10$ ,  $D = 1$  and  $h = \frac{1}{2}$ , for example, the volume  $V$  is calculated from the formula. Two other values of  $V$  are calculated changing only  $L$ , say to 5 and 20. These three solutions of  $V$  will locate both the  $D$  and the  $100h/D$  lines at the points of intersection ( $D = 1$  and  $100h/D = 50$ ) of the three construction lines. This same process is needed to establish other points on the  $100h/D$  scale by solving the equation using  $D = 1$  and  $L = 10$ , but changing  $h$  to get the desired values of  $100h/D$ .

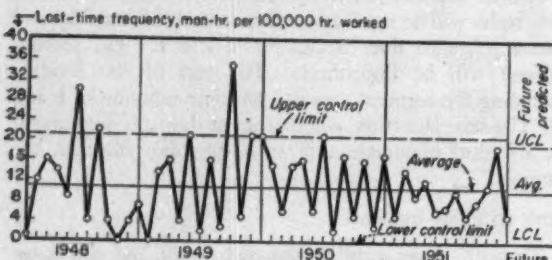
Then, the remaining points of the  $D$  scale are established by again using the formula and varying the values of  $D$ . In this particular tube problem the  $D$  scale is logarithmic.

A scale for the angle of slant  $\theta$  may easily be constructed from the relationship  $L = h \cot \theta$  as a means of determining  $L$  when the angle of slant and  $h$  are known. An additional scale for  $h$  could also be constructed for the  $L = h \cot \theta$  relationship, but the  $D$  scale can be used for both  $h$  and  $D$ , since the  $D$  scale meets all the requirements of any  $h$  values.

One example of establishing a point on the angle  $\theta$  scale will suffice for all desired points on it. For the point  $\theta = 3$  deg., let  $h = \frac{1}{2}$  and find  $L = 9.54$ . Then let  $h = 1$  and find  $L = 19.08$ . The intersection of these construction lines establishes the point  $\theta = 3$  and also the distance that the  $\theta$  scale is from the  $L$  and  $D$  and  $h$  scales. All the scales and the reference line are parallel.

As an example of use of the chart, a 1½-in. I.D. pipe slanted at 3 deg. has an obstruction ½ in. high. What is

the trapped volume and how high up the tube will it reach? Here  $100h/D = 40$ . Connect  $\frac{1}{2}$  on the  $h$  scale through 3 deg. to  $L = 9.6$ . Connect from  $L = 9.6$  through  $D = 1\frac{1}{2}$  and extend to the reference line. Connect the reference intersection with  $100h/D = 40$  and read  $V = 1.87$  cu. in.



## Control Chart Tests Effect of Industrial Safety Programs

WILLIAM C. SOUDRIETTE, Cities Service Oil Co., East Chicago, Ind.

The ultimate goal of every industrial safety program is to reduce the number of accidents which occur. Determining whether a decrease in any period represents a real improvement or is caused by chance variation is somewhat difficult unless evaluated with the assistance of a simple statistical procedure. It has been found that many types of accident reports may be analyzed through the use of the control chart for number of defects, commonly called the c-Chart.

The fundamental theory behind statistical quality control is that all variations in nature are brought about by a combination of chance and assignable causes. Assignable causes (in the case under consideration, safety hazards) can be detected by the use of control charts as they evidence themselves as points above the control limits. By the use of past records and probabilities the chance variation limits may be predicted so that any point falling beyond these limits is fairly certain to result from some assignable cause, i.e., a hazard or unsafe practice.

The use of this method is illustrated by the following example which utilizes a hypothetical lost-time frequency record with the data selected from a table of random numbers.

Lost-Time Frequency, Man Hr. per 100,000 Hr. Worked

	1948	1949	1950	1951
January	1	1	15	5
February	12	14	6	14
March	16	16	15	19
April	14	4	16	12
May	9	21	6	6
June	30	2	21	7
July	4	16	2	10
August	22	3	17	5
September	4	35	5	8
October	0	5	16	11
November	4	21	3	19
December	7	21	17	5

The table lists lost time frequencies for each month for a four-year period. The average lost-time frequency per month for the period is denoted as  $c_{av}$  and is equal to  $542/48$  or 11.29. The data are then plotted and control

limits are computed and drawn on the graph. The limits are calculated as follows: Upper control limit =  $c_{av} + 3 \sqrt{c_{av}}$  =  $11.29 + 3(3.36) = 21.37$ ; Lower control limit = 0.

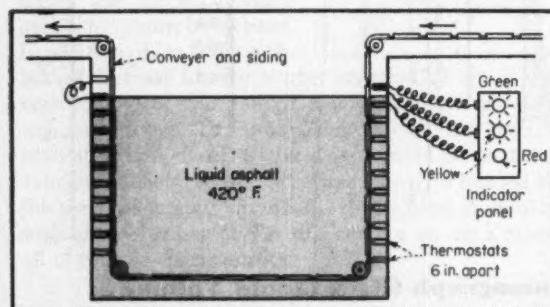
### CHART SHOWS LACK OF CONTROL

The results indicate that for a given plant and operations peculiar to it, the lost-time frequency would fluctuate between 0 and 21 if only chance causes were operating. In the case illustrated three points fall above the upper control limit which indicates that some assignable cause was responsible for this so-called lack of control. Checks will usually indicate these out-of-control points were caused by introduction of new or modified operations not in previous use, resulting in serious accidents. By keeping this type of chart it is possible to predict whether or not the radical variations are normal or caused by some faulty procedure which should be remedied.

For the last two years in the illustration it appears that the effectiveness of the safety program has increased. To determine this point the four-year record, excluding the three points which were out of control (over 21), is used to calculate new and closer control limits for projecting on a graph of the future months. Based on the 45 months showing control, the projected average lost-time frequency is 10.11 and the upper and lower control limits are 19.65 and 0, respectively. If the succeeding months fall within these limits it is an indication that the program is having the desired effect. As time goes by and the safety record improves, narrower and narrower limits may be computed with an overall lowering of the average rate.

### REFERENCES

- American Society For Testing Materials, "Manual on Presentation of Data," Committee E-1 (1951).
- Grant, E. L., "Statistical Quality Control," McGraw-Hill Book Co., Inc., New York (1946).



### Thermostats Measure Liquid Level

Thermostats are not usually considered as level-measuring instruments. However, they were so used in a recent application on hot asphalt at 420 deg. F. The idea is extremely simple: By using thermostats at various levels in the tank, and setting them at slightly below the liquid temperature, those thermostats above the level will close and light pilot lights, while those below will open and leave their lights dark.

The installation was one made by the Flintkote Co., East Rutherford, N. J., in a 15-ft. deep dip tank used for saturating insulated siding with liquid asphalt. This method

was used because the high temperature and extreme viscosity of the asphalt interfered with operation of most level indicating instruments. The installation consisted of two rows of Fenwal Thermoswitches, each with 11 units spaced 6 in. apart. The rows were staggered vertically so as to have one thermostat every 3 in. The reason for covering so much of the height is that the tank level is varied from time to time to govern the amount of penetration of the saturant.

At any given operating level it is necessary to use three thermostats to show whether the level is "high," "correct," or "low." The plant men connect any adjoining three to an indicator light panel by means of pronged connectors. Then, since the thermostats are set to open at a temperature of 375 deg. F., the one above the level, controlling the green light, will be closed, allowing the green light to burn. The one controlling the yellow "safe-level" light will blink on and off with slight changes in level, while the red light, indicating too low a level, will be lighted only in cases of abnormal operation. Neither high temperature nor high viscosity impair the operation in any way. If desired this arrangement can also be used quite easily for feed pump control.

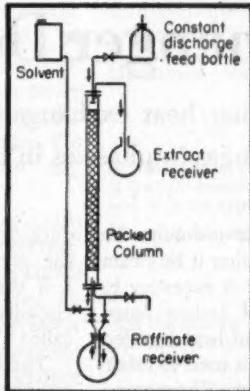
### Simple Hookup Solves Problem in Liquid-Liquid Extraction

J. D. Ross, Chemical Engineer, Oregon Forest Products Laboratory, Corvallis, Ore.

Our problem was to determine the practicability of a liquid-liquid extraction involving an aqueous organic solution and an organic solvent. Since no equipment was available for the job it was necessary to construct a small packed column. This consists of a standard section of borosilicate glass pipe, 2 x 60 in., packed with  $\frac{1}{4}$ -in. Raschig rings. Overhead supply tanks were installed to store solvent and feed stock and provide gravity flow for continuous operation.

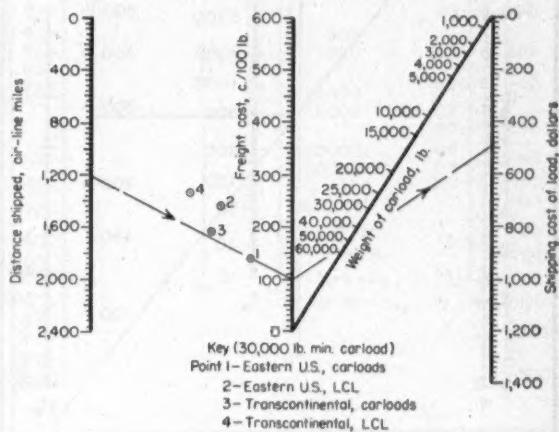
First trials were made by manually controlling the feed inlet, raffinate discharge, and solvent inlet. This proved unsatisfactory because of the irregular flow rates of feed and solvent, and the inability to maintain a consistent extract/raffinate ratio. The aqueous solution, being somewhat viscous, did not flow evenly, and it was difficult to control the location of the interface at the desired point in the column.

The apparatus was therefore modified according to the accompanying sketch. The feed tank was discarded and replaced with an aspirator bottle fitted for constant discharge (Mariotte's Bottle). At the bottom of the column, a 5-liter flask was installed with tubing connections to the raffinate outlet and the solvent inlet. Since the feed was the dispersed phase, in operation the flask and column were completely filled with solvent and the solvent supply



tank then valved off. The feed solution was then admitted, passing down the column into the flask, and displacing an equal volume of solvent upward through the column and into the extract receiver. This permitted a "continuous batch" operation that was quite successful.

Although this procedure limited the extract and raffinate flow to approximately equal volumes, consistent operation was achieved and fairly reliable data were obtained.



### Freight Costs for Equipment Shown by Nomograph

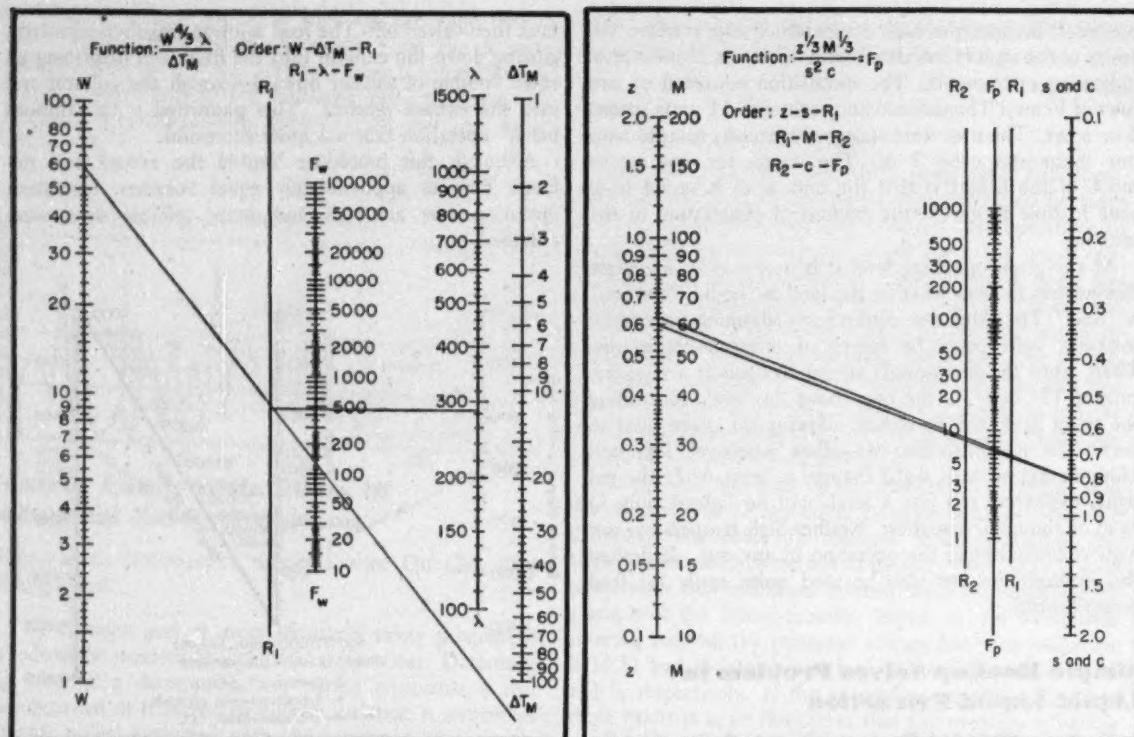
JACQUES R. LA POINTE, Chemical Engineer, Pittsburgh Coke & Chemical Co., Neville Island, Pittsburgh, Pa.

In its special issue on equipment cost estimation (May 1947, p. 125) *Chemical Engineering* discussed freight costs on equipment and pointed out that freight had best be estimated separately and not considered simply as an element of installed cost if shipping distances are great and detailed installation costs are known. For estimating purposes the article gave four equations for approximate costs in cents per 100 lb., based on the second class rate for machinery.

These equations are: For eastern U. S. the carload rate (30,000 lb. min. carload) in cents per 100 lb. is given by  $25 + 0.06 M$  and the less-than-carload rate by  $55 + 0.12 M$ . Corresponding transcontinental rates are: carload rate (30,000 lb. min. carload),  $-75 + 0.16 M$ , and LCL rate,  $-80 + 0.26 M$ . Here  $M$  is the air-line distance to the receiving point.

By combining a line coordinate chart with a Z chart we secure a useful nomograph from which both unit costs and total freight costs can quickly be obtained. For example, for 100 lb. transported 1,200 miles in eastern U. S., the cost per 100 lb. is 97 c. For a 50,000-lb. car over this distance the cost is \$485.

Although these equations go back to May 1947 it has been found that for cost estimates the freight rate still closely approximates the second class rate for machinery. If the total cost found with the chart is multiplied by the ratio of the cost index for the present date, compared with May 1947, a conservative figure results which is reliable enough for most cost estimates.



FOR work factor for heat transfer—all four equations (p. 217). FOR liquid physical property factor—all four equations.

## Shortcut to Heat Exchanger Design—III

You can cut in half the time required for designing heat exchangers by the conventional methods. Here's how to do it when a fluid changes in phase as in heaters and condensers.

### C. H. GILMOUR

In heat exchanger design, problems which concern the heating of fluids by condensing steam are of considerable importance. Or the problems may involve the condensation of process vapors using cooling water or any other fluid, either gaseous or liquid, as a cooling medium.

In the first instance the heat exchanger would be called a heater. In the second instance the heat exchanger would be called a condenser.

For the fluid which undergoes no change in phase, such as the cooling water or process fluid being heated, the methods for computing the heat exchange factors and the pressure drop factors have already been shown in Articles I and II.

However, for the fluid which under-

goes a change of phase (namely, the condensing vapor, whether it be steam or a process vapor), it is necessary to develop a new set of factors based upon this mechanism of heat transfer.

The formula which is used to calculate the film coefficient of heat transfer for condensing vapors is called the Nusselt formula and is expressed in two ways depending upon whether the tubes are vertical or horizontal.

For vertical tubes<sup>1</sup>:

$$h = 0.925 k \left[ \frac{\sigma \rho^2}{\mu \Gamma} \right]^{1/2}$$

For horizontal tubes<sup>2</sup>:

$$h = 0.760 k \left[ \frac{\sigma \rho^2}{\mu \Gamma} \right]^{1/2}$$

In these equations, all the physical properties are for the liquid film formed in the condensation process.

The following units for the various factors apply:  $k$  is the thermal con-

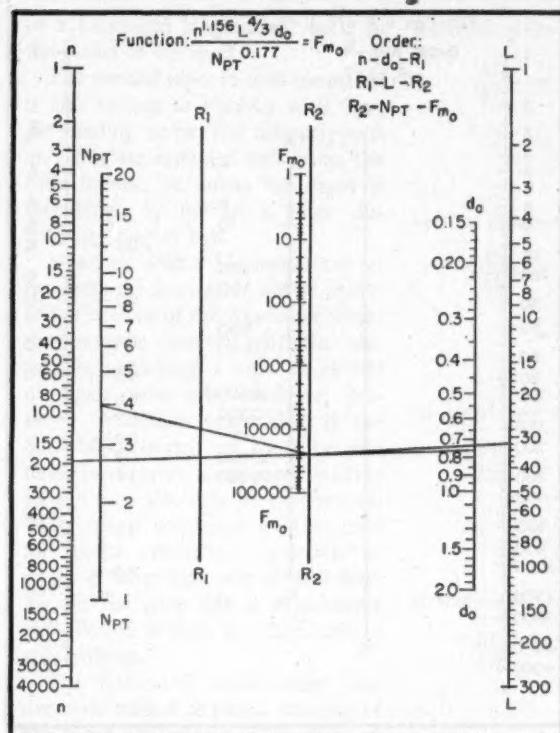
ductivity in Btu./hr./ft./deg.,  $F$  is the gravitational constant in ft./hr.<sup>2</sup>;  $\rho$  is the density in lb./ft.<sup>3</sup>;  $\mu$  is the viscosity in lb./hr.-ft., and  $\Gamma$  is a term called "tube loading" in lb./hr.-ft.

The latter term is a function of the position of the tube (i.e., whether horizontal or vertical) and of the placement of the fluid (i.e., whether on the tube side or the shell side of a heat exchanger).

All of the other factors are not influenced either by tube position or by placement of the fluid. So the physical property and the work factor will be a constant for any particular problem.

There are, of course, other possible positions of the tube in a condenser, namely inclined at any angle from zero to 90 degrees from the horizontal. This case can be treated in the same manner as the two cases presented here. However, this has not been

C. H. GILMOUR is staff engineer with Carbide and Carbon Chemicals Co., at S. Charleston, W. Va.



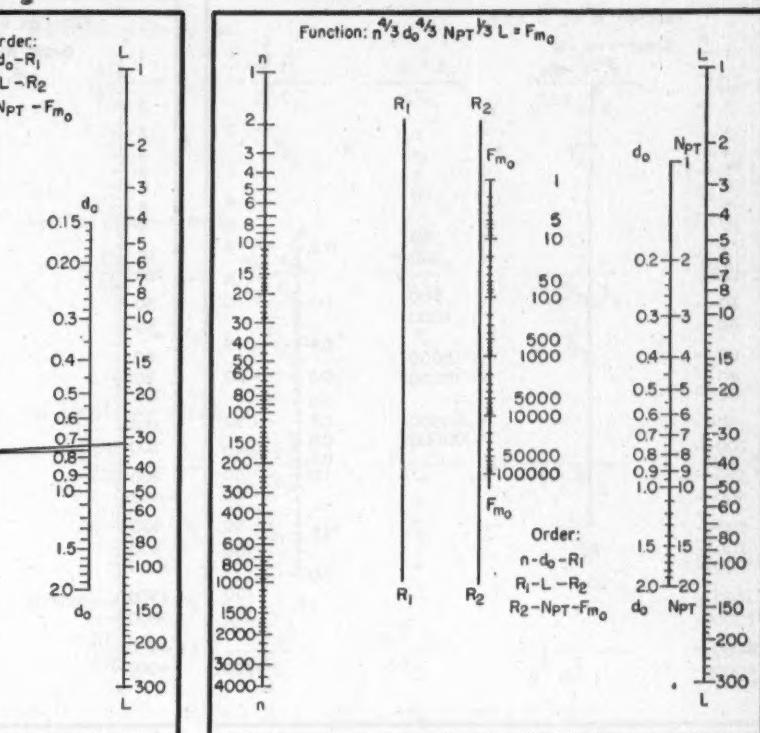
FOR mechanical design factor, Eq. III-1.

done. For those who desire inclined heaters or condensers, it would be safe design to assume they are vertical. If, in the future, there appears to be interest in a more exact solution for this case, the author will develop the necessary heat transfer factors and computation sheets.

In the preceding articles for fluids without phase change the temperatures used on the computation sheets could be expressed in either deg. C. or deg. F. Reason: in the work factor for all four columns the temperature range was divided by the temperature difference. Since both of these methods represented a difference, the ratio remained the same regardless as to whether deg. C. or deg. F. were used.

However, in the development of the expression for condensers the latent heat of vaporization appears in the work factor—and this is usually expressed in terms of btu./lb. Thus it becomes necessary to use deg. F. when expressing temperature difference. If centigrade temperatures are used a different numerical factor may be used to compensate for this.

Only factor in the Nusselt equation that may be unfamiliar is the term  $\Gamma$ . For the various tube positions and



FOR mechanical design factor, Eq. III-2.

fluid placements this term is defined as follows:

#### Horizontal Vapor-in-Shell

$$\Gamma = \frac{W}{n_r \times 2L}$$

$n_r$  is the number of tube rows across the center of the tube bundle,  $L$  is the tube length in feet, and  $W$  is the vapor condensed in lb./hr.

#### Vertical Vapor-in-Shell

$$\Gamma = \frac{W}{n_b \times d_o / 12}$$

$n_b$  is the number of tubes in the tube bundle and  $d_o$  is the outside diameter of the tube in inches.

#### Horizontal Vapor-in-Tube

$$\Gamma = \frac{W}{n \times 2L}$$

$n$  and  $L$  are the number of tubes in parallel and the series length in feet, respectively.

#### Vertical Vapor-in-Tube

$$\Gamma = \frac{W}{n \times \pi d_i / 12}$$

$n$  and  $d_i$  represent the number of tubes in parallel and the inside diameter of the tubes in inches, respectively.

Starting with the Nusselt formula, the Weber formula for thermal con-

#### About "Shortcuts To Heat Exchanger Design"

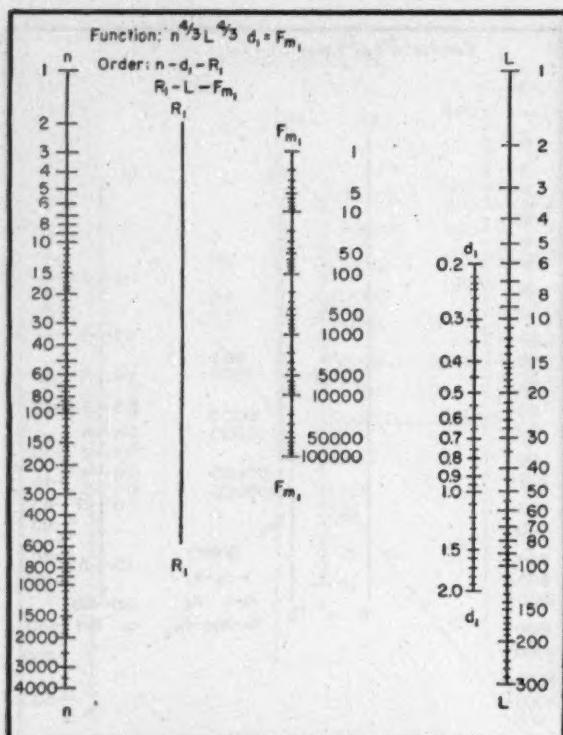
**NOTE**—The first article in this series (Oct. 1952, p. 144) developed a basic method for the design of heat exchangers. Use of the method for conditions of no phase change, forced convection, turbulent flow, and cross flow in shell was described.

Article II in the March issue (p. 226) described the use of the basic method for conditions of no phase change, forced convection, turbulent flow, and parallel flow in shell.

This article deals with heaters and condensers in which the condensing vapors contain no more than a small

amount of superheat or non-condensable vapor. Remaining articles in this series will cover the case where there is a considerable amount of one or the other, also the case where the condensate is subcooled.

It will be necessary to refer to the first article for certain alignment charts, nomenclature, as well as development of the basic method. When you do, please note that  $W^*$  was omitted under work factors for pressure drop in Eq. VII. In this same equation the exponent on the term  $P$  is a 3.—EDITOR.



FOR mechanical design factor, Eq. III-3.

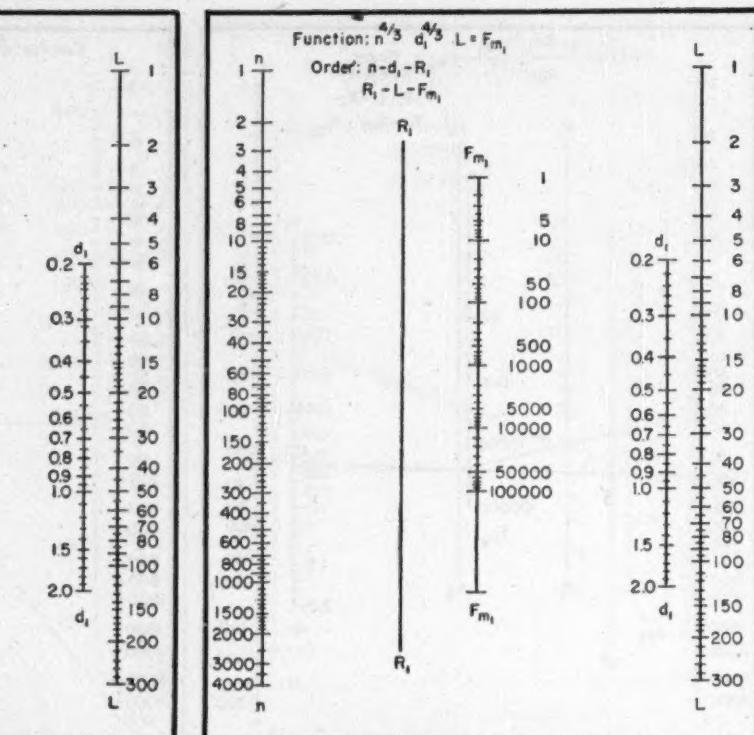
ductivity, the heat balance equation, and the expression relating the shell diameter to the tube diameter and number of tubes in a heat exchanger—we may develop four equations for the heat transfer factor for condensers (see Eqs. III-1 through III-4). If centigrade units are used for temperatures then all of the numerical factors in these equations should be divided by 1.8 or should read 2.64, 4.75, 2.92, and 4.75 respectively.

#### PRESSURE DROP

Methods for determining pressure drop on the condensing side of heat exchangers are not nearly as clear cut as the methods for estimating heat transfer coefficients.

This is not surprising when the process of condensation is considered, because you have a varying mass flow throughout the exchanger. You also have tubes that are wetted with condensate, whereas the fluid upon which friction is acting is a vapor.

Usually each designer will have his own method of determining the pressure drop to be expected. In this article the author has used the Fanning<sup>4</sup> equation and has multiplied by a factor designated as  $f_{ns} = 0.5$  which is the method suggested by Kern.<sup>5</sup>



FOR mechanical design factor, Eq. III-4.

The author of this article would not expect to estimate pressure drops for condensing vapors with any great degree of accuracy—the main use of the pressure drop calculation being to prevent designs which would result in enormous or impossible pressure loss conditions. For single pass, vapor-in-tube condensers this factor will be approximately 0.3, the loss in the reversals of flow in the heads being responsible for the higher value in multi-pass units. Note that the viscosity and specific gravity (referred to liquid water) are for the vapor and are labeled with a subscript  $v$ .

For the shell side, the estimated pressure drop is figured in exactly the same manner as that for fluids in cross flow on the shell except that the numerical factor is lower and the specific gravity is that of the vapor compared with liquid water. Here again the accuracy is not very high but it is completely satisfactory for design purposes.

#### SELECTION OF TYPE OF CONDENSER

Since the designer has a choice of four types of condensers, it would be appropriate to consider advantages and disadvantages of each type.

Although it is well known that con-

densing coefficients for horizontal tubes are more than two times higher than those for vertical tubes, this is seldom the criteria on which selection is based. Space requirements, materials of construction, and even personal prejudices usually dictate the type of condenser to be used.

The horizontal vapor-in-shell condenser is used to a large extent for steam condensers and feed preheaters in the heat and power industry, and as process vapor condensers in the petroleum and chemical industries.

A long tube, small diameter condenser of this type has the disadvantage that non-condensable gases are given an opportunity to separate in the vicinity of the condensate outlet end of the condenser—thus blanking off useful heat transfer area. This condition may be overcome by making the exchanger short but large in diameter and using longitudinal baffles at various points around the periphery of the shell—so that the incoming vapor makes one pass across the tube bundle on the way to the steam trap or drainer. Another method is to use "split-flow," in which the vapors are caused to flow from the center to either end of the exchanger and then back to the center again by the use

of a horizontal longitudinal baffle in the center of the shell.

The vertical vapor-in-shell condenser is also subject to troubles with inert gas binding unless the tube supports or baffles are extended well across the tube bundle, or unless the vapor is introduced by use of a vapor distributing ring or belt.

However, with a 25 percent cut on the baffle the inert gases will be driven to the bottom of the condenser where they may be removed with the condensate or through a vent. A vertical multipass tube side condenser possesses the disadvantage that if the fluid being heated on the tube side tends to vaporize, some vapor binding on the tube side may be experienced. This type of condenser is often used for forced circulation vaporizers in which a rather high rate of fluid flowing on the tube side is superheated and allowed to flash in a flash-tank or still column.

The horizontal vapor-in-tube condenser is subject to partial flooding of the tubes by condensate, thereby reducing the net heat transfer area for condensation. This will be more noticeable in multi-pass units than in single pass units.

In order that this condition of tube flooding is not carried too far, an additional mechanical design factor labeled  $F_{m_2}$  is provided. It is stipulated on the computation sheet that when the quotient of  $W/n s d_i^{2.5}$  exceeds 0.3 then this factor is 1.3.

It is probably not good design to go above a value for this quotient of 0.5. This type of condenser has the advantage that high coolant coefficients may be obtained in the shell side; also high vapor condensing coefficients may be obtained on the tube side. It possesses good characteristics for non-condensable gas removal and is used most often where U-bend construction is desirable.

The vertical vapor-in-tube condenser should always be a single pass condenser since it is rather unsatisfactory to have the vapor and condensing liquid flows opposing each other. The factors for this condition are given on the assumption that the number of passes on the tube side will always be unity. This type of condenser has the advantages that inert constituents will be driven to the cold end and high heat transfer coefficients may be obtained on the shell side.

#### Horizontal vapor-in-shell

$$\frac{\Delta T_o}{\Delta T_m} = 4.75 \frac{M_o^{\frac{1}{3}} z_o^{\frac{1}{3}}}{S_o^2 C_o} \frac{W_o^{\frac{4}{3}} \lambda_o}{\Delta T_m} \frac{N_{PT}^{0.177}}{n^{1.56} L^{\frac{4}{3}} d_o} \quad (III-1)$$

$$= F_{n_o} \times F_{p_o} \times F_{w_o} \times \frac{1}{F_{m_o}}$$

#### Vertical vapor-in-shell

$$\frac{\Delta T_o}{\Delta T_m} = 8.55 \frac{M_o^{\frac{1}{3}} z_o^{\frac{1}{3}}}{S_o^2 C_o} \frac{W_o^{\frac{4}{3}} \lambda_o}{\Delta T_m} \frac{1}{n^{\frac{4}{3}} d_o^{\frac{4}{3}} N_{PT}^{\frac{1}{3}} L} \quad (III-2)$$

$$= F_{n_o} \times F_{p_o} \times F_{w_o} \times \frac{1}{F_{m_o}}$$

#### Horizontal vapor-in-tube

$$\frac{\Delta T_i}{\Delta T_m} = 5.25 \frac{M_i^{\frac{1}{3}} z_i^{\frac{1}{3}}}{S_i^2 C_i} \frac{W_i^{\frac{4}{3}} \lambda_i}{\Delta T_m} \frac{1}{n^{\frac{4}{3}} L^{\frac{4}{3}} d_i} \quad (III-3)$$

$$= F_{n_i} \times F_{p_i} \times F_{w_i} \times \frac{1}{F_{m_i}}$$

#### Vertical vapor-in-tube

$$\frac{\Delta T_i}{\Delta T_m} = 8.55 \frac{M_i^{\frac{1}{3}} z_i^{\frac{1}{3}}}{S_i^2 C_i} \frac{W_i^{\frac{4}{3}} \lambda_i}{\Delta T_m} \frac{1}{n^{\frac{4}{3}} d_i^{\frac{4}{3}} L} \quad (III-4)$$

$$= F_{n_i} \times F_{p_i} \times F_{w_i} \times \frac{1}{F_{m_i}}$$

#### EXAMPLE

The use of the computation sheet for exchangers in which one of the fluids is a condensing vapor may be shown by considering Example 12.1, Process Heat Transfer, Kern, p. 274.

This problem calls for the design of a horizontal vapor-in-shell condenser in which 60,000 lb. per hr. of n-propyl alcohol is to be condensed at 244 deg. F. The cooling medium is water at 85 deg. F., the fouling factor is 0.003, and the allowable pressure drops are 2 psi. for the vapor and 10 psi. for the water. Tubes are to be  $\frac{1}{2}$  in. O.D. by 16 BWG 8 ft. long.

Only physical property which is not given in the problem by Kern is the specific heat of the n-propyl alcohol which can be obtained from the chart on p. 804 of "Process Heat Transfer." At 244 deg. F. the value is 0.81.

Cooling water is on the tube side and the position of the tubes is to be horizontal. For the condensing vapor, the physical properties are recorded in their respective columns and the physical property factor determined from the nomograph for liquid physical property factor which accompanies this article. To calculate the work factor the weight rate of vapor to be condensed, the latent heat, and the mean temperature difference are re-

corded in their respective columns. The work factor is obtained from the alignment chart bearing the title "Work Factor for Heat Transfer."

The physical properties and work factor properties for the tube side, tube wall, and fouling columns are recorded in the manner explained in Article I, and the factors are obtained from the nomographs published therein.

To obtain the mechanical design factor a trial and error solution is usually required but for the purposes of this illustration we have used the number of tubes, number of passes, and baffle pitch which appear in the solution to the example as given by Kern. The sum of the products of the various heat transfer factors is very close to unity and, therefore, we may say that we arrive at the same answer that appears in the example referred to above. The agreement on pressure drop is not as close. Nevertheless, the pressure drops as calculated are within the allowable range and are sufficiently accurate.

There is nothing unique or fortuitous in the fact that the same result is obtained by both methods because, after all, they are in fact the same method and the basic design data are identical. This emphasizes the importance of giving rating engineers all the

HEAT EXCHANGER COMPUTATION SHEET FOR HEATERS AND CONDENSERS							
Material	Tube side		Shell side		Tube wall		Fouling
	Gas Liquid	Condensing vapor	Gas Liquid	Condensing vapor	Copper Stainless steel	Enameled Steel	Scale-Ter Polymer
<b>HEAT TRANSFER CALCULATIONS</b>							
Numerical factor $F_n$	Gas 2.48	Liquid 2.82	Condensing vapor — °C — °F	2.92 475 5.25 456	Position Hor. Vert. Tri. Sq.	Spacing Hor. Vert. 0.426 0.004 0.270 0.342	Position Hor. Vert. 159 3820
Liquid physical property factor $F_p$	1.0 0.72 18 1.0 1.65 $F_{p_1}$	$C_1$ $Z_1$ $M_1$ $S_1$ $F_{p_1}$	$C_0$ $Z_0$ $M_0$ $S_0$ $F_{p_0}$	$C_0$ 0.81 $Z_0$ 0.62 $M_0$ 626 $S_0$ 0.8 $F_{p_0}$ 6.5	$c_1 /$ $k 226$ $c_1/k 426$ $c_1/h_0 334$ $c_1/h_0 334$	$c_0 /$ $h_0 334$ $c_0 /$ $h_0 334$ $c_0 /$	
For gases →	Omit		Omit				
Work factor $F_w$	458 $W_1$ 35°H-L 141 $\Delta T_M$	$W_1$ $\lambda_1$ $\Delta T_M$ $F_{w_1}$	$W_0$ $T_H - T_L$ $\Delta T_M$ $F_{w_0}$	$W_0$ 60 $\lambda_0 285$ $\Delta T_M 141$ $F_{w_0} 475$	$W_1 458$ $H-L 35$ $\Delta T_M 141$ $W_1(\lambda_1)$ $\Delta T_M \approx \Delta T_M$	$W_1 458$ $H-L 35$ $\Delta T_M 141$ $W_1(\lambda_1)$ $\Delta T_M \approx \Delta T_M$	
Mechanical design factor $F_m$	19.5 $n$ 0.62 $d_1$ 32 $L$	$n$ $NPT$ $L$	$n$ $NPT$ $P$	$d_0$ 0.75 $d_1$ 0.62 $d_0 - d_1$ 0.13	$d_0$ 0.75 $d_1$ 0.62 $d_0 - d_1$ 0.13	$n$ 19.5 $d_0$ 0.75 $L$ 32	
	$0.62 F_{m_1}$ $32 F_{m_2}$	$F_{m_1}$ $F_{m_2}$	$F_{m_0}$ $F_{m_0} = \frac{1}{2600}$	$d_0$ 0.75 $F_{m_0} = \frac{1}{2600}$	$d_0 - d_1$ 0.13 $nd_0 L$ 4610	$d_0 - d_1$ 0.13 $nd_0 L$ 4610	$1$ $nd_0 L$ 4610
Product $F_n \times F_p \times F_w \times F_m$	0.106			0.564	0.002	0.300	
<b>PRESSURE DROP CALCULATIONS</b>							
Physical property factor $f_p$	0.72 $z_1$ 1.0 $s_1$ 0.95 $t_{p_1}$	$z_1$ $s_1$ $t_{p_1}$	0.326 $s_0$ $b_{v_0}$ $t_{p_0}$	0.000 $b_{v_0}$ 0.0001 21	Product tube	0.106	
Work factor $f_w$	5.3 $f_{w_1} = \frac{(W_1)^{1.0}}{n}$		$f_{w_0} = \frac{f_{w_1}}{W_0^2}$	3600	Product shell	0.564	
Mechanical design factor $f_m$	12.9 $L/d_1$ 446 U-bend or straight +25 Sum x NPT 87.9 $f_{m_1}$ 151 $f_{m_2}$	+16 +25		$\frac{8}{33000 \times 37}$	Product wall	0.002	
	$f_m = \frac{f_{m_1}}{f_{m_2}}$	0.5	$f_{m_0} = \frac{f_{m_1}}{L/P^2 D_0}$		Product fouling	0.300	
$f_p \times f_w \times f_m = \Delta P$	8.0	ΔP per shell	0.59		Sum of products	0.972	
ΔP x No. of shells	8.0	ΔP total	0.59		This sum must be equal to or less than 1		
<b>MEAN TEMPERATURE DIFFERENCE (CORRECTED) <math>\Delta T_M</math></b>							
	Heating and cooling temperature ranges and abscissa and parameter of $\Delta T$ correction factor charts.				Item No. Horizontal Vapor-in-Shell n-Propanol Condenser		
$\Delta T_H$ 15°	$t_H$ 120	High	244 $t_H$		Surface area:		
$\Delta T_L$ 124	$t_L$ 85	Low	244 $t_L$		1200 sq. ft.		
Differ. 35°	$t_H - t_L$ 35°	K/R					
Ratio 1.28	$t_H - t_L$ 205°	1-2 2-4 3-6 4-8			Size:		
$\Delta T_M$ 141	AVE 102		244 TAVE		Number of tubes = 766		
$F_{MTD}$ 1	*Or $t_H - t_L$ whichever is larger positive value	Passes $F_{MTD}$			Outside diam. of tubes = 3/4"		
$\Delta T_M$ 141					Length of shell or length of single tube pass = 96"		

\*If quotient of  $W_1/nd_0^{2.56}$  exceeds 0.3  $F_{m_0} = 1.3$  — otherwise  $F_{m_0} = 1.0$

\*\*Vertical vapor-in-tube condensers will always be single pass or  $NPT = 1$

basic design data including fouling factors, because otherwise it is quite likely that various rating engineers will arrive at different designs for any given problem. In fact, if the author

of this article were given this problem without the stipulations of tube size and length, fouling factor, and placement of the fluid—he would use a fouling factor of 0.001 and arrive at

a design calling for about 1,000 sq. ft. in a 27 in. shell rather than 1,200 sq. ft. in a 31 in. shell.

Without belittling the very comprehensive calculations indicated in Kern's approach to the problem, it should be quite obvious that the use of the computation sheet presented here shortens the amount of work involved in solving heater and condenser problems.

Note also that this method also always takes care of the resistance of the tube metal. This was ignored in the calculations by Kern. That this omission was justified for this particular problem is indicated by the magnitude of the factor for tube wall which is 0.002 out of a total of 0.972 or only 0.2 of 1 percent. However if the tubes were made of Hastelloy Alloy "B" with a thermal conductivity of 6.6, the tube wall factor would have been  $0.002 \times 226/6.6 = 0.0685$ , representing a contribution of about 6.6 percent to the total area required.

#### TYPES OF EXCHANGERS ADAPTABLE

The method described in Article III is applicable for the design of liquid or gas heaters, forced circulation calandrias or vaporizers, process vapor condensers, and steam condensers. The steam or condensing vapors may contain a small degree of superheat or a small amount of non-condensable vapor provided the saturated temperature is used as the vapor temperature.

Computations for the case of condensers in which there is a considerable amount of superheat or a considerable amount of non-condensable gases will form the subject of a later article in this series.

#### NOMENCLATURE

Only terms which appear on the computation sheet which have not been described in the previous articles are:  $\lambda$  which is the latent heat of vaporization in Btu./lb. and the subscript  $v$  which denotes properties of the vapor rather than the liquid.

#### REFERENCES

- Kern, Process Heat Transfer, McGraw-Hill Book Co. Inc.
- 1 P. 265, eq. 12.39. This is identical with the equation as written in this article. The factor 1.47 divided by  $4^{1/3} = 0.925$ ; and  $G^2 = \Gamma$ .
- 2 P. 265, eq. 12.40. This is also identical with the equation for horizontal tubes. The factor 1.51 divided by  $4^{1/3} = 1.26$ ; and  $2G = \Gamma$  as defined in this article.
- 3 P. 52, eq. 3.44.
- 4 P. 273, eq. 12.47 and sentence preceding this equation.

# Next Time, Use Statistics

Illustrated with down-to-earth practical examples, this article and one to follow describe more than a dozen ways in which chemical engineers can increase the accuracy and speed of their everyday work.

**P. FERENZ and B. H. LLOYD**

Statistical methods can no longer be described as new. They have proved themselves in many different fields.

Yet there is need for wider application of statistical methods in the chemical industry. To meet this need, chemical engineers must be trained in statistics on a practical level.

This will not be accomplished by producing statisticians. Rather it will be done by introducing new ways of thinking.

What statistical techniques are available? How are they used? What advantages do they offer over the methods we are now using? Can they be used to solve problems heretofore shelved because of their complexity?

There are many good books on applied statistics, and a few have been written in the interest of the chemist and the chemical industry.<sup>1, 2, 3</sup> Some of these deal briefly with methods of quality control, but modern texts tend to cover a broad field of application.<sup>4, 5</sup>

Chemical engineers working in production, design, research or development want to know where they can use statistics in their everyday work. We disregard in this article, therefore, problems of a more or less general nature encountered in every industry, such as sales statistics, market forecasts, problems of industrial hazards, reliability of cost estimates, and so on. The statistical treatment of such problems follows established lines, usually

without much consideration for special features of the chemical industry.

In many other problems, however, special aspects of the chemical industry have to be taken into account when applying statistical procedures.

## Meaning of Observed Values

In chemical operations we can easily regulate such variables as temperature, pressure and concentration within certain limits. These limits depend to some extent on human behavior—that is, how promptly and accurately an operator can react to the signals given by a measuring device. (The term measuring device is used here in the widest sense, including chemical analysis, sensual reactions, etc.) However, we have to recognize the real meaning of these signals—readings on our thermometers, chemical analyses and, generally, all data pertaining to operating conditions.

The reading on our thermometer may change in time, and it may change because of incomplete mixing of the fluid. The reading might be different when we use another thermometer. Thus when we find that the temperature of our reactor is, say, 10 deg. C., we can consider that figure only as an

estimate of the average temperature.

Now assume that our process is such that temperatures higher than, say, 15 deg. C. should not occur at any time and at any point in the reactor, as in the case when manufacturing nitrated explosives. Then we have to know whether there is some probability of a 5-deg. difference between the temperature at any point in the reactor and the observed average temperature.

Furthermore, we have to consider the unavoidable temperature variations because of various cooling effects. These can be caused by differences in temperature of the brine, by variations in the flow rate inside the coil, and by radiation losses, depending on atmospheric conditions. These latter variations cause temporary deviations whose adjustment takes time and whose effect is superimposed on the effect of incomplete mixing.

Thus we have here a statistical problem—to calculate the probability of the occurrence of a 5-deg. deviation locally and temporarily, based on many observations averaging 10 deg. C. In the manufacture of explosives the permissible probability would have to be extremely low because of the serious hazard involved.

## HOW ONE PLANT SAVES \$3 MILLION A YEAR

An extensive statistical quality control system is paying off handsomely at Radford Arsenal. Use of this system has brought about a reduction in equipment and operating personnel, with savings of \$3,150,000 per year.

Hercules Powder Co., operator of the arsenal, established statistical quality control in collaboration with Ordnance Corps personnel. The plant makes "bazooka" or rocket powder.

Added bonuses are increased production, higher percentage yields, improved quality. The number of inspection steps has been substantially reduced. In spite of much higher costs, these improvements have permitted Hercules to hold the price of powder to the same approximate level as in 1945.

Quality control is only one aspect of statistics treated in the accompanying article and the one to follow. Full appreciation and use of this powerful tool can undoubtedly save the chemical industry many more millions.

PAUL FERENZ and B. H. LLOYD are with Canadian Industries Limited in Montreal, Canada. Dr. Ferencz was the author of an article published in *CE* last April on the use of statistics in cost estimation. Another article to follow soon will deal with such aspects of statistics as distribution and relationships of variables.

Similar considerations apply to any measurement. Take the case of superphosphate manufacture:

Assume the analytical result shows that our product contains 20.3 percent available  $P_2O_5$ . The product is stored in piles, from which samples have been taken and analyzed. The stored pile is made up of a number of batches from material produced under more or less different conditions, and the  $P_2O_5$  content in the pile would not be uniform for that reason. Furthermore, in each batch or in each production period the material might be inhomogeneous due to inadequate mixing, forming of lumps, etc. On top of that, segregation in layers with different compositions might occur in large piles.

Not only may the analytical results differ from the true composition because of sampling and analytical errors, but in many cases—and superphosphate is a good example of this—we don't even have such a thing as true composition. The composition will change because of curing of the material, making more  $P_2O_5$  soluble, or a reversion into insoluble  $P_2O_5$  may occur. Moisture evaporates and new material is added to the pile while shipments are removed from it.

The practical problem when selling products based on their composition, therefore, is not to determine the exact composition. Such products are usually sold with some allowance for inaccuracies of sampling. The analytical result found by the seller is accepted unless the difference determined by the buyer or by an umpire exceeds a certain previously agreed-upon value.

Let us say, in the assumed case, that the limits of uncertainty agreed upon are  $\pm 0.2$  percent  $P_2O_5$ . The statistical problem, then, will be to work out a sampling plan that will seldom give us a result in error by more than 0.2 percent  $P_2O_5$ . The number of times that these limits will be violated is fixed by a preassigned probability. That is, we want to be sure that 95 percent of the time, for example, the buyer will not find less than 20.1 percent when our analysis shows 20.3 percent.

It is not necessary to cite further cases to illustrate our point; those mentioned above permit us to look at the problem in a general way. In the case of temperature in a nitrator we

measured a property several times and saw that we cannot expect to get exactly the same value each time. Small deviations are likely to occur for the reasons explained. The analytical results of samples taken from a pile of superphosphate are likely to show relatively large deviations. Evidently more uncontrolled factors are in effect there, greater even than the uncontrolled factors in the case of the temperature.

In both cases, and generally in all cases of measurements, the object on which the measurement is made is to be characterized by a certain property. We see now that this cannot be done by giving an answer on the basis of just one measurement.

Because every measurement is subject to variations or errors we have to make several measurements. We may consider each measurement as a sample from the infinite number of measurements which could be made. The question is then whether or not our measurements are properly sampled; that is, are the resulting observations such that we are justified in drawing conclusions based on the observed values. Evidently this will be the case only when the observed values are distributed approximately according to the same pattern as the infinite number of values which could be obtained.

Now let us consider only measurements which are made simultaneously or made on objects whose measured property does not change in time—for instance, simultaneous readings on several thermometers, or analytical results of samples taken from an isolated pile of a stable material.

Measurements such as these will have a tendency to distribute themselves around a certain value. This distribution will be such that as the number of measurements increases, the proportion of the values above or below any arbitrarily fixed value will become more or less constant. For an infinite number of values the proportion of values below the arbitrarily fixed point is constant. The constant proportion will depend on the magnitude of the arbitrarily fixed value about which the proportion is taken. This is the law of probability on which the entire structure of statistics is based.

The implications of the law of probability make it possible to determine whether or not we have sampled properly in estimating the considered

property based on the sample values. This will be the case when the observed values conform to certain rules, that is, when they are randomly chosen.\*

Let us consider eight samples from a pile of superphosphate. The analytical results are 19.8, 20.1, 20.3, 19.6, 20.5, 19.8, 19.7 and 20.4 percent  $P_2O_5$ .

These values appear to be randomly chosen. This can be confirmed by applying a test of randomness. Thus these figures can be used to calculate the average  $P_2O_5$  content and to estimate the accuracy of the measurement which is subject to deviations because of incomplete mixing of the material, analytical errors and so on.

### Sampling Problems

Materials in the chemical industry are to a large extent produced in bulk quantities. Rarely during process stages do chemical materials appear in separate, identifiable units, such as containers. Quite often, however, they are prepared in bags or packages for shipping. For example, chemical fertilizers are shipped in 100-lb. bags and dynamite in cylindrical cartridges.

The problems of bulk sampling are essentially different from those characterized by individual pieces or parts. There the theory of sampling has been mathematically derived by representing the sample as a point in an  $n$ -dimensional space, where  $n$  is the number of elements in the sample.

There are no identifiable elements in bulk sampling. The sampling unit is generally not related to the bulk quantity of material. One drop from a well mixed tank of liquid is a good sample; a carload of lump coal from a few carloads might be a poor sample. The quantity of material in a sample depends entirely on the consistency of the material sampled. For lumpy materials, where large discrepancies in chemical composition are likely to be present, the quantity of material in the sample must be enough to overcome gross misrepresentation.

When determining how large our sample should be several samples are taken at, say, 10 g. each, and studied for variation. The amount is increased to 20 g., and so on, several samples being taken at each stage. Visual inspection of the results will often indicate the approximate minimum

quantity permissible to avoid large variations from sample to sample.

For coal, ores, slag and other solid materials the sample must be crushed in some manner and resampled. This procedure is repeated until the sample is reduced to a size suitable for chemical analysis. The laboratory sample will not truly represent the original sample, nor will the original sample truly represent the bulk, owing to error of sampling. Knowledge of the original sampling error and the laboratory sampling error are as important as the eventual measurement.

The amount by which the value of a chemical analysis differs from the true value of a bulk quantity of material may be divided into several parts. The composition of the primary sample deviates from the true composition of the bulk material sampled because of sampling error. Unless the whole amount of the primary sample is subjected to chemical analysis there is an additional error between the composition of the portion analyzed, known as the laboratory sample, and the composition of the primary sample. Lastly, there are inherent errors in the analytical operation, which are grouped together and called the analytical error. The analytical error plus the error of the laboratory sample are known collectively as the laboratory error.

The over-all error, then, is a combination of the primary sampling error and the laboratory error. To determine the over-all sampling error several samples must be taken from the bulk. In doing this it is customary to assume that samples are independent units. Chemists are familiar with the practice of performing duplicate analyses for determining the analytical error. However, few chemists have acquired the habit of attaching limits of uncertainty to their results.

The number of samples to be drawn can be determined quite sensibly by first setting limits of uncertainty and applying this in a statistical formula with the over-all sampling error. However, that method is reliable only when our material is rather homogeneous. Otherwise the distribution of the sample values will depend to an extent on the size of samples and, to an even larger extent, on the bias during sampling, which hardly can be eliminated in case of inhomogeneous lumpy materials.

Where it is discovered that a large number of samples is necessary for the degree of precision required in the result, there are often ways of reducing the number of analyses necessary. Compositing samples which have been prepared for analysis is one technique. Compositing is simply thoroughly mixing samples to obtain one combined sample.

Knowledge of sampling and laboratory costs can be taken into consideration in obtaining a balance of the number of samples, the number of composites and the number of duplicate analyses. In all sampling there are sampling errors, whether they are known or not, or whether or not they behave in some systematic manner. Although there are limitations to the statistical approach, there is no known method that gives more information about the validity of the result.

### Significance of Deviations

Suppose that analyses of superphosphate made on each shift during a period of two weeks varied between 20.1 and 20.7 percent available  $P_2O_5$ , averaging 20.4 percent; thereafter, on two consecutive days, we find 20.3, 20.1, 20.5, 20.1, 20.2 and 20.2 percent. Is there any reason to suspect that something is wrong in the sampling or in production? The statistical problem is to find out whether the last six relatively low values could be obtained with a sufficiently high probability just because of variations in the product which normally occur under steady conditions.

When analyzing our product we sometimes find one or a few values which do not seem to agree with the values as regularly obtained. For instance, we find once in a while a higher moisture content; thus in the series of determinations 2.1, 2.3, 2.6, 2.0, 1.9, 2.2 percent, the third value, 2.6, would make us suspicious that something is wrong in that special case. We have to decide whether that value is likely to occur once in a while in a series as given above, merely by chance, or whether there is some special reason for that higher value for moisture content.

While in the previous case the consecutive low  $P_2O_5$  values suggest that some new factor permanently affects the results of our operation, in the latter case we have to suspect the

presence of one factor which shows up only occasionally. In the language of statistics we would say that the problem is to find out whether the value of 2.6 percent belongs to the same population as the other values.<sup>1</sup>

In estimating the average moisture from the results should this apparent extraneous value be included or discarded? There is a strong tendency among chemists and engineers to discard such outlying values because they do not appear to be representative. Statistical tests applied to the data here would not reject the value of 2.6.

Experience will often tell whether or not a value is obviously absurd. If there is any doubt, a statistical test will help, but careful consideration should be given to increasing the number of samples. Using a so-called stratified sampling plan should be given consideration in some cases. The best rule to follow is not to reject an observation unless there are good grounds for doing so.

Deteriorations as well as improvements have to be detected in our operations at an early stage. As soon as our statistical calculations confirm our suspicion of significantly differing observations we have to trace the causes of these deviations, to find what new factors have entered into our operating conditions or what occasionally prevailing factor might have caused temporary deviations.

There are a great many other cases where statistical tests can be usefully applied to decide whether or not apparent differences are significant. Two analytical methods may be compared, say, in the determination of potassium content as chloroplatinate and as perchlorate, respectively. Two series of tests can be made using some highly pure potassium salt. The results obtained by the two methods will differ in the average values as well as in the scatter of the results around their averages.

Based on the analytical results we can calculate whether or not one method is significantly more accurate than the other. We can apply the same test to compare the reliability of two analysts, the difference in the quality of two catalysts, the efficiencies of individual workmen or of shifts, of performances of equipment, and so on.

An interesting case occurs when we want to know to what extent some

property of two products may overlap. Many chemicals are manufactured in different degrees of purity. Red lead oxide is manufactured in three grades—less than 95 percent, 97 percent and 98 percent. The  $Pb_3O_4$  content of each grade is likely to vary somewhat in different shipments. The question then arises whether there is a sufficiently high probability that the quality of the 97 percent product might equal or exceed that of the 98 percent degree because of the variations in the  $Pb_3O_4$  content. If this is so then the customer will not be inclined to pay a premium for the higher grade.

### Statistical Quality Control

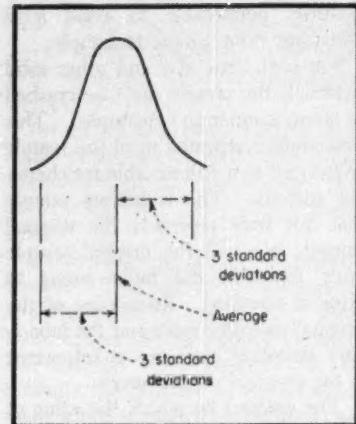
The importance of early detection of disturbances in operations has led to the development of statistical quality control. This technique makes use of a chart which is simple to construct and easy to read.

The basis of the chart is a measure

of the natural variation of a quality characteristic, such as percent total  $P_2O_5$  in phosphate rock. This natural variation is measured in terms of the standard deviation. For homogeneous materials, values of percent total  $P_2O_5$  will be distributed about an average, the distribution being bell-shaped or normal (see cut). Three standard deviations about the average will include nearly all the values belonging to homogeneous material.

In the first control chart below, upper and lower control limits have been calculated for values taken from phosphate rock considered to be homogeneous. On this chart daily production values are plotted to detect significant trends towards sub-standard material. The example shown here exhibits a trend and shows quite markedly the point at which action was taken to prevent sub-standard material.

The quality control chart method of analysis has been largely confined to more or less mechanical processes.



NORMAL distribution of variables.

Because of the number and complexity of the variables in the chemical industry, applications of the control chart are more restricted.

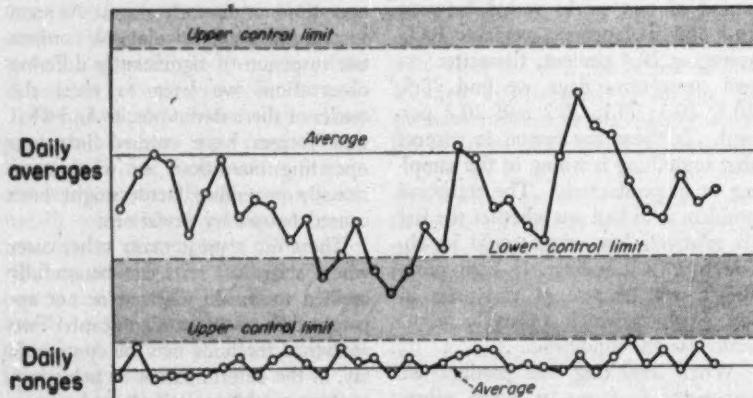
Unfortunately this has not always been realized by statistical quality control specialists making application of the control chart to chemical processes. The results, in some cases, have been very sad indeed.

The main reason for failures of the statistical quality control chart is that too much has been expected of this simple technique. Consider, for example, a chart constructed to detect trends in excess sulphuric acid content in batches of superphosphate. Three samples are taken from each batch, and the average of the three analytical results is plotted in the chart.

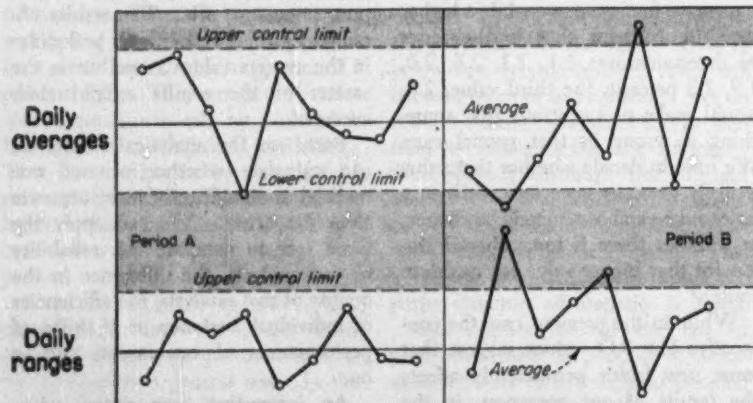
A basic assumption is that the three samples are to be chosen at random from the batch. Another important assumption is that the variation among the three samples is the same for each batch. The so-called within-batch variation is represented by the range of the three sample values, that is, the difference between the highest and lowest value of the three. This is shown in the second chart (left).

Therefore, in addition to an average value, each batch has a corresponding range value which checks the variation of the batch. The ranges will naturally vary amongst themselves, but they should all reflect the same within-batch variation to the extent permitted by sampling error. An upper control limit on the range chart is the limit of variation among the ranges allowed by chance sampling error. Points falling outside of this limit indicate

(Continued on page 226)



CONTROL chart for superphosphate; note where corrective action was taken.



WITHIN-BATCH variations in Period B vitiate the control chart here.

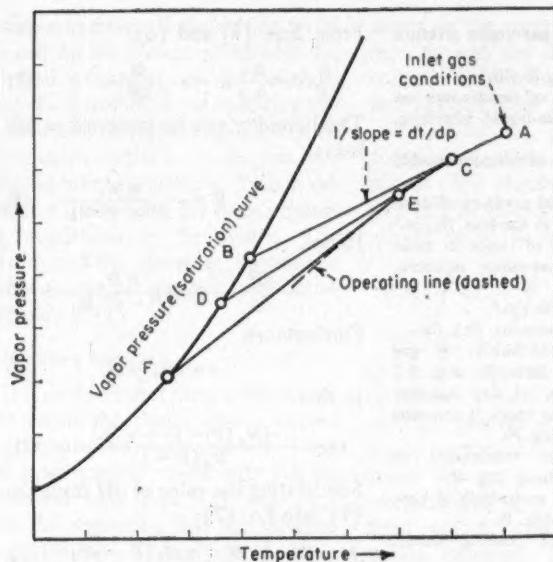


Fig. 1—How the point-to-point calculations are applied to the design of a condenser via the t-p diagram.

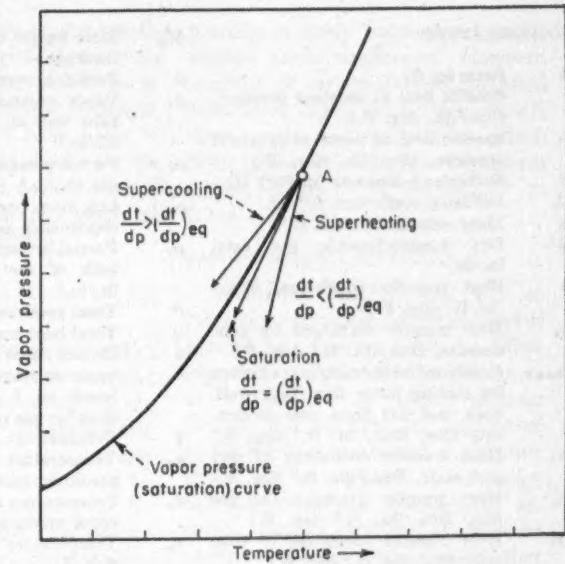


Fig. 2—How vapor-gas mixtures may superheat or even supercool (theoretically), depending on ratio of heat to mass transfer.

## Design of Cooler Condensers for Vapor-Gas Mixtures—I

Design methods used previously have been limited to saturated gas-vapor mixtures which remain saturated during condensation. Here is a new general method, suitable even in case of superheating.

### G. H. BRAS

Presented here is a new, largely graphical method for the design of cooler condensers for handling mixtures of noncondensable gases and saturated or non-saturated vapors. Previously the method of Colburn and Hougen<sup>1</sup> has been available for calculating the required condenser surface area and this method has been adequate for those cases where a saturated gas-vapor mixture remains saturated during the cooling and simultaneous condensation. However, the mixture does not always remain saturated but may become superheated or, theoretically, supercooled. The new

method will handle the situation regardless of whether the mixture continues saturated, or not.

When such a mixture of vapors is introduced into a cooler condenser, condensation of the vapors starts as soon as the temperature of the cooling tube wall falls below the dewpoint of the gas mixture. To calculate such a condenser, heat and mass transfer coefficients must be known, and can be computed from information in the literature. The driving forces for both the heat and mass transfer can be calculated as soon as the temperature and vapor pressure in the main bulk of the gas, and the cooler wall temperature, are known.

The new method permits following the condition of the gas-vapor mixture with respect to temperature and vapor pressure as it passes through the cooler. A relationship (Eq. 17) derived theoretically for dilute gas-vapor

mixtures is the basis of the method which is applied graphically to a temperature-pressure diagram to show the point-to-point temperature-vapor pressure relation of the mixture as it passes from entrance to exit of the condenser. The temperature and vapor pressure of the condensate on the tube walls is found by trial and error as in the Colburn-Hougen method,<sup>1</sup> as well as the value of the unit heat transfer,  $U\Delta t_{cw}$ . Finally, the cooling surface area for the condenser is obtained by graphical integration of Eq. (18).

Colburn and Hougen have shown<sup>1</sup> that the unit heat transfer,  $U\Delta t_{cw}$ , can be calculated by a trial-and-error solution of the equation:

$$U \Delta t_{cw} = \frac{h_g (t_g - t_c)}{h_{cond} (t_g - t_w)} + K'M_s \lambda (p_v - p_c) = \quad (1)$$

When a saturated gas-vapor mixture is cooled down, the corresponding temperatures of the gas mixture and the

G. H. BRAS, chemical engineer of Weert, Netherlands, has used the method described here successfully under a wide variety of conditions. Part II, to appear in an early issue, will take the reader through a complete design calculation by the new method.

## NOMENCLATURE

<i>A</i>	Area, sq. ft.	<i>M<sub>m</sub></i>	Mole weight of gas-vapor mixture (average)
<i>c</i>	Specific heat at constant pressure, Btu./(lb. deg. F.)	<i>p</i>	Partial pressure, lb./in. <sup>2</sup>
<i>c<sub>v</sub></i>	Specific heat of vapor at constant pressure, Btu./(lb. deg. F.)	<i>p<sub>s</sub></i>	Vapor pressure of condensate on tube wall at gas-liquid interface, lb./in. <sup>2</sup>
<i>C</i>	Sutherland constant (in Part II)	<i>p<sub>n</sub></i>	Partial pressure of noncondensable gas, lb./in. <sup>2</sup>
<i>D<sub>s</sub></i>	Diffusion coefficient, ft. <sup>2</sup> /hr.	<i>p<sub>lf</sub></i>	Log mean partial pressure of noncondensable gas in the film, lb./in. <sup>2</sup>
<i>G</i>	Mass velocity, lb./(hr. ft. <sup>2</sup> )	<i>p<sub>v</sub></i>	Partial pressure of vapor in main bulk of the gas-vapor mixture, lb./in. <sup>2</sup>
<i>G'</i>	Dry noncondensable gas rate, lb./hr.	<i>P</i>	Total pressure, lb./in. <sup>2</sup>
<i>h</i>	Heat transfer coefficient, Btu./(hr. ft. <sup>2</sup> deg. F.)	<i>q</i>	Total heat transferred, Btu./hr.
<i>h<sub>c</sub></i>	Heat transfer coefficient for condensate, Btu./(hr. ft. <sup>2</sup> deg. F.)	<i>s</i>	Humid heat (enthalpy) of gas vapor mixture, Btu./(lb. deg. F.) based on 1 lb. of dry noncondensable gas plus vapor it contains
<i>h<sub>sw</sub></i>	Combined heat transfer coefficient for cooling water film, tube wall, scale and dirt films, and condensate film, Btu./(hr. ft. <sup>2</sup> deg. F.)	<i>t</i>	Temperature, deg. F.
<i>h<sub>d</sub></i>	Heat transfer coefficient of dirt and scale, Btu./(hr. ft. <sup>2</sup> deg. F.)	<i>t<sub>c</sub></i>	Temperature of condensate at gas-liquid interface, deg. F.
<i>h<sub>g</sub></i>	Heat transfer coefficient in gas film, Btu./(hr. ft. <sup>2</sup> deg. F.)	<i>t<sub>f</sub></i>	Temperature of main bulk of gas-vapor mixture, deg. F.
<i>h<sub>t</sub></i>	Heat transfer coefficient of tube wall, Btu./(hr. ft. <sup>2</sup> deg. F.)	<i>t<sub>w</sub></i>	Temperature of cooling water, deg. F.
<i>h<sub>w</sub></i>	Heat transfer coefficient of cooling water, Btu./(hr. ft. <sup>2</sup> deg. F.)	$\Delta t$	Temperature drop through gas film, deg. F.
<i>H</i>	Humidity, lb. vapor/lb. dry noncondensable gas.	$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p}$	Overall temperature drop between gas-vapor mixture and cooling water, deg. F.
<i>H(Z)</i>	Ackermann's correction factor, Eq. (24)	<i>T</i>	Pressure drop through gas film, lb./in. <sup>2</sup>
<i>j</i>	Heat and mass transfer factor, Eqs. (2) and (3) (from ref. 2, Fig. 2)	<i>U</i>	Absolute temperature, deg. K.
<i>k</i>	Thermal conductivity, Btu./(hr. ft. <sup>2</sup> deg. F. per ft.)	<i>P</i>	Overall heat transfer coefficient, Btu./(hr. ft. <sup>2</sup> deg. F.)
<i>K</i>	Mass transfer coefficient, lb./(hr. ft. <sup>2</sup> ) per unit pressure	$\rho$	Density, lb./ft. <sup>3</sup>
<i>K'</i>	Molecular mass transfer coefficient, lb.-mole/(hr. ft. <sup>2</sup> ) per unit pressure	$\lambda$	Latent heat of condensation, Btu./lb.
<i>M<sub>v</sub></i>	Mole weight of vapor	$\mu$	Viscosity, lb./(hr. ft.)
<i>M<sub>g</sub></i>	Mole weight of gas	<i>Pr</i>	Prandtl number = $\mu c/\kappa$

cooling water can be found by a simple heat balance.

But, as we have seen, the method shown<sup>1</sup> is not sufficient in certain cases and the simple heat balance can not be used to give corresponding gas and cooling water temperatures. For example, if unsaturated gas-vapor mixtures are cooled with simultaneous condensation of a part of the vapor, then the vapor pressure of the gas mixture becomes unknown after cooling over a certain temperature range. The vapor pressure then depends on the rate of vapor diffusion to the cooled tube walls. In other cases it is possible for the mixture, although initially saturated, to become superheated with respect to its vapor pressure. What occurs, that is, whether the mixture will show a superheating or a saturating tendency, depends on the relation between the amount of heat transferred and the amount of mass transferred. As we shall see later, heavy vapors with a low diffusivity will generally show a saturating tendency,

<i>M<sub>m</sub></i>	Mole weight of gas-vapor mixture (average)	From Eqs. (5) and (6):
<i>p</i>	Partial pressure, lb./in. <sup>2</sup>	$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = s \frac{dt}{dH}$ (7)
<i>p<sub>s</sub></i>	Vapor pressure of condensate on tube wall at gas-liquid interface, lb./in. <sup>2</sup>	The humidity can be expressed as follows:
<i>p<sub>n</sub></i>	Partial pressure of noncondensable gas, lb./in. <sup>2</sup>	$H = \frac{p Mv}{(P - p) Mg}$ (8)
<i>p<sub>lf</sub></i>	Log mean partial pressure of noncondensable gas in the film, lb./in. <sup>2</sup>	Hence,
<i>p<sub>v</sub></i>	Partial pressure of vapor in main bulk of the gas-vapor mixture, lb./in. <sup>2</sup>	$\frac{dH}{dp} = \frac{P Mv}{(P - p)^2 Mg}$ (9)
<i>P</i>	Total pressure, lb./in. <sup>2</sup>	Furthermore,
<i>q</i>	Total heat transferred, Btu./hr.	$c = s/(1 + H)$ (10)
<i>s</i>	Humid heat (enthalpy) of gas vapor mixture, Btu./(lb. deg. F.) based on 1 lb. of dry noncondensable gas plus vapor it contains	so that:
<i>t</i>	Temperature, deg. F.	$s = c \frac{[Mv(P - p) + p Mg]^2}{Mv(P - p)}$ (11)
<i>t<sub>c</sub></i>	Temperature of condensate at gas-liquid interface, deg. F.	Substituting the value of dH from Eq. (9) into Eq. (7):
<i>t<sub>f</sub></i>	Temperature of main bulk of gas-vapor mixture, deg. F.	$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = \frac{dt}{dp} \cdot \frac{s Mv(P - p)^2}{Mv P}$ (12)
<i>t<sub>w</sub></i>	Temperature of cooling water, deg. F.	and substituting Eq. (11) into Eq. (12):
$\Delta t$	Temperature drop through gas film, deg. F.	$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = \frac{dt}{dp}$
$\Delta t_{sw}$	Overall temperature drop between gas-vapor mixture and cooling water, deg. F.	$\frac{c [Mv(P - p) + p Mg]^2}{Mv} \cdot \frac{(P - p)}{P}$ (13)
<i>Δp</i>	Pressure drop through gas film, lb./in. <sup>2</sup>	The mean molecular weight of the gas-vapor mixture can be written:
<i>T</i>	Absolute temperature, deg. K.	$Mm = Mv(P - p)/P + p Mg/P$ (14)
<i>U</i>	Overall heat transfer coefficient, Btu./(hr. ft. <sup>2</sup> deg. F.)	Substituting this value into Eq. (13) gives:
<i>P</i>	Density, lb./ft. <sup>3</sup>	$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = \frac{dt}{dp} \cdot \frac{c Mm(P - p)}{Mv}}$ (15)
$\lambda$	Latent heat of condensation, Btu./lb.	and combining Eq. (15) with Eq. (4) gives the relation:
$\mu$	Viscosity, lb./(hr. ft.)	$\frac{c Mm p_{lf}}{Mv} \cdot \left( \frac{k}{c \rho D_v} \right)^{2/3} \cdot \frac{\Delta t}{\Delta p} =$
<i>Pr</i>	Prandtl number = $\mu c/\kappa$	$\frac{dt}{dp} \cdot \frac{c Mm(P - p)}{Mv}}$
<i>Sc</i>	Schmidt number = $\mu/\rho D_v$	or

while light vapors with a high diffusivity may cause superheating of the mixture.

## HEAT AND MASS TRANSFER

The new method given here is based on the theoretical relation existing between heat and mass transfer in the same field. As Chilton and Colburn have shown,<sup>2</sup> heat and mass transfer coefficients may be expressed as follows:

$$h = \frac{j c G}{(\epsilon c/\mu)^{2/3}} \quad (2)$$

$$K = \frac{j G M<sub>v</sub>}{M<sub>m</sub> p<sub>lf</sub> (\mu/c\rho D_v)^{2/3}} \quad (3)$$

From Eqs. (2) and (3) it follows that:

$$\frac{h}{K} = \frac{c M<sub>m</sub> p<sub>lf</sub>}{M<sub>v</sub>} \cdot \left( \frac{k}{c \rho D_v} \right)^{2/3} \quad (4)$$

where  $k/c\rho D_v$  is the quotient of the Schmidt and Prandtl numbers. The heat and mass transferred per unit of time and per  $dA$  surface area are respectively:

$$h \Delta t dA = G' s dt \quad (5)$$

$$K \Delta p dA = G' dH \quad (6)$$

$$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = s \frac{dt}{dH} \quad (7)$$

The humidity can be expressed as follows:

$$H = \frac{p M<sub>v</sub>}{(P - p) M<sub>g</sub>} \quad (8)$$

Hence,

$$\frac{dH}{dp} = \frac{P M<sub>v</sub>}{(P - p)^2 M<sub>g</sub>} \quad (9)$$

Furthermore,

$$c = s/(1 + H) \quad (10)$$

so that:

$$s = c \frac{[M<sub>v</sub>(P - p) + p M<sub>g</sub>]^2}{M<sub>v</sub>(P - p)} \quad (11)$$

Substituting the value of dH from Eq. (9) into Eq. (7):

$$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = \frac{dt}{dp} \cdot \frac{s M<sub>v</sub>(P - p)^2}{M<sub>v</sub> P} \quad (12)$$

and substituting Eq. (11) into Eq. (12):

$$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = \frac{dt}{dp} \quad (13)$$

The mean molecular weight of the gas-vapor mixture can be written:

$$M<sub>m</sub> = M<sub>v</sub>(P - p)/P + p M<sub>g</sub>/P \quad (14)$$

Substituting this value into Eq. (13) gives:

$$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} = \frac{dt}{dp} \cdot \frac{c M<sub>m</sub>(P - p)}{M<sub>v</sub>} \quad (15)$$

and combining Eq. (15) with Eq. (4) gives the relation:

$$\frac{c M<sub>m</sub> p<sub>lf</sub>}{M<sub>v</sub>} \cdot \left( \frac{k}{c \rho D_v} \right)^{2/3} \cdot \frac{\Delta t}{\Delta p} =$$

$$\frac{dt}{dp} \cdot \frac{c M<sub>m</sub>(P - p)}{M<sub>v</sub>} \quad (16)$$

In the case of condensation,  $p_{lf}/(P - p) > 1$ , if  $p$  is the vapor pressure in the main bulk of the gas-vapor mixture. The value approaches unity for dilute gas-vapor mixtures, so for those cases:

$$\frac{dt}{dp} = \left( \frac{k}{c \rho D_v} \right)^{2/3} \cdot \frac{\Delta t}{\Delta p} \quad (17)$$

It is evident that Eqs. (16) or (17) can be used to determine the direction of change (slope of the operating line) for the cooling of a gas-vapor mixture on the  $t - p$  plane. Here the value of  $dt/dp$  is the cotangent (reciprocal of slope) of the operating line at the

point in question. If the driving forces  $\Delta t$  and  $\Delta p$  are known, along with the physical properties of the mixture, then the direction of the operating line is fixed and the operating line can be constructed on the  $t-p$  diagram by a point-to-point calculation. Such a calculation is necessary due to the changing conditions in the cooler. The direction of the operating line may be assumed to be straight over short distances only.

#### CONDENSER DESIGN

It is assumed that the gas-vapor mixture enters the cooler with a known temperature and vapor pressure. Heat and mass transfer coefficients can be calculated with Eqs. (2) and (3), with the restriction that the value of  $p_s$  is unknown. The value of the combined heat transfer coefficient for the cooling water film, dirt and scale film, tube wall, and condensing liquid film can be calculated in the usual way. If then the amount of cooling water required and the maximum cooling water outlet temperature are fixed, Eq. (1) can be solved by trial and error, giving temperature and vapor pressure of the condensate layer at the gas entrance side of the cooler condenser.

Thus, the values of the driving forces  $\Delta t$  and  $\Delta p$  can be calculated. From Eqs. (16) or (17) the value for  $dt/dp$  can be obtained. Next, a straight line AB is drawn through the starting point A (Fig. 1) representing  $dt/dp$ . This line is the cotangent to the operating line of the gas-vapor mixture at point A. Point A represents the inlet gas conditions. The straight line may be followed over a short distance only, to point C, which is the second point for which Eq. (1) has to be applied. Thus, the corresponding condensate layer temperature and vapor pressure for point C are found.

Again, values for  $\Delta t$  and  $\Delta p$  are determined, and another value for  $dt/dp$  is obtained, which is drawn on the  $t-p$  diagram as line CD. In this way the procedure is repeated until the required outlet gas temperature is reached. The difference in heat content of the gas-vapor mixture between two succeeding points can easily be calculated, as well as the heat content of the condensed liquid. So, the cooling water temperature can be found from point to point by a heat balance.

How many points are required de-

pends on the curvature of the operating line and the degree of exactness required for the design. About six to ten points will be generally sufficient.

By solving Eq. (1) from point to point, point values for  $U\Delta t_{ss}$  are obtained. The required cooling surface area can be calculated by a graphical integration of the equation:

$$A = \int dA = \int -\frac{dq}{U\Delta t_{ss}} \quad (18)$$

The use of the normal equation  $A = Q/U_{ss}\Delta t_{ss}$  may be seriously in error, especially if the composition of the gas-vapor mixture changes greatly during condensation.<sup>1</sup> If the cooler condenser has to be designed for non-saturated gas-vapor mixtures, or for those saturated mixtures that do not remain saturated, the point-to-point procedure has to be applied anyway, and the additional graphical integration is not too time-consuming. An example will be worked out in a later article to show clearly how the design method is used.

#### SUPERHEATING IN CONDENSERS

If a saturated gas-vapor mixture is brought in contact with a colder tube wall or condensed liquid film, the value for  $\Delta t/\Delta p$  can be calculated as the quotient of the driving forces through the gas film. From this value for  $\Delta t/\Delta p$  and the physical properties of the gas film, the value of  $dt/dp$ , the cotangent to the operating line in the  $t-p$  diagram, can be calculated with Eqs. (16) or (17). The value of  $dt/dp$  so obtained should now be compared with the slope of the vapor pressure (equilibrium) curve  $dt/dp_{eq}$  at the temperature of the gas-vapor mixture (point A in Fig. 2). If  $dt/dp < dt/dp_{eq}$ , there will definitely be a tendency of the gas-vapor mixture to become superheated with respect to its vapor pressure. In the  $t-p$  diagram of Fig. 2 this is clearly shown. If  $dt/dp = dt/dp_{eq}$ , the gas-vapor mixture will remain saturated. If  $dt/dp > dt/dp_{eq}$ , the gas mixture will even have a tendency toward supercooling. Since supercooling in a turbulent gas mixture is not likely, it is probable in commercial cooler condensers that the mixture will remain saturated in this case too. The last case generally applies to mixtures of air and heavy, slow-diffusing organic vapors. The second case, saturation, is approximately correct for the system air-water vapor. The first case, super-

heating, is rarely encountered in industrial cooler condensers. However, mixtures of carbon dioxide, saturated with water vapor, should theoretically show such a superheating effect. Schmidt<sup>2</sup> has calculated for this system  $k/c_p D_s = 0.653$ , or  $(k/c_p D_s)^{1/2} = 0.754$ .

#### DRIVING FORCE CORRECTION

In deriving Eqs. (16) and (17), no correction was made for the amount of sensible heat transferred by the diffusing vapor. In case of large differences of temperature or vapor pressure through the gas film, the amount of additional heat transferred in this way should not be neglected if the design calculations require considerable accuracy. Eqs. (5) and (6) can then be written as follows, if it is assumed that the temperature and partial pressure gradients remain straight:

$$h\Delta t dA + K\Delta p dA \Delta t c_1 = G's dt \quad (19)$$

$$K\Delta p dA = G'dH \quad (6)$$

or

$$\frac{(h + K\Delta p c_1)}{K} \cdot \frac{\Delta t}{\Delta p} = s \frac{dt}{dH} \quad (20)$$

$$\frac{h}{K} \cdot \frac{\Delta t}{\Delta p} + c_1 \Delta t = s \frac{dt}{dH} \quad (21)$$

As shown in Eqs. (7) and (15):

$$s \frac{dt}{dH} = \frac{c M_m (P - p_g)}{M_s} \cdot \frac{dt}{dp} \quad (22)$$

Hence, from Eqs. (21) and (22) and Eq. (4):

$$\frac{dt}{dp} = \frac{p_{eq}}{(P - p_g)} \cdot \left( \frac{k}{c_p D_s} \right)^{1/2} \\ \cdot \frac{\Delta t}{\Delta p} + \frac{\Delta t c_1 M_s \Delta p}{\Delta p c M_m (P - p_g)} \quad (23)$$

or

$$\frac{dt}{dp} = \frac{\Delta t}{\Delta p} \cdot \frac{1}{(P - p_g)} \\ \cdot \left[ p_{eq} \left( \frac{k}{c_p D_s} \right)^{1/2} + \Delta p \left( \frac{c_1 M_s}{c M_m} \right) \right] \quad (24)$$

It can be seen that Eq. (20) contains a modified value for the coefficient of total sensible heat transfer, which may be written as  $(h + K\Delta p c_1)$ . The modification is comparable with Ackermann's Eq. (86) (ref. 8), with the exception that Ackermann has added a factor  $H(\Sigma)$ . This factor has a value between 0.5 and 1.0, and is a function of the quotient of the amount of sensible heat transferred by the diffusing vapor and that transferred by normal heat convection. Colburn and Drew<sup>3</sup> have derived equations similar to those of Ackermann for the case of simultaneous heat and mass

transfer in a field with large temperature and partial pressure differences. The factor introduced by these authors is due to the fact that the temperature drop through the film becomes a curved line, if substantial amounts of sensible heat are transferred by the diffusing vapor. For the derivation of the correction factor, the original literature should be consulted. As a first approximation, however, it is safe enough in many cases to assume the correction factor to be equal to 0.5; it is then to be applied to the last term in Eq. (24).

In other equipment for simultaneous heat and mass transfer where the same equations apply, for example in cooling towers, the sensible heat transferred by the diffusing vapors may be found negative in comparison with the sensible heat transferred by normal heat convection. In those cases, the sign of the correction group applied to Eq. (24) is negative.

Ackermann<sup>6</sup> has pointed out that the thickness of the film is influenced by

the diffusing vapor molecules. Generally, the gas film becomes thicker in case of evaporation, drying or humidification, but thinner in case of condensation. Since the changing thickness of the gas film involves both heat and mass transfer, the value of  $h/K_s$  is not changed, and Eqs. (16), (17) and (24 corrected) remain applicable. For the calculation of the effect of diffusion on the thickness of the gas film, the original paper should be consulted.

#### ENTHALPY DESIGN METHOD

Merkel<sup>8</sup> has proposed using the difference in enthalpy as the driving force for both heat and mass transfer. The method is based on the mass transfer coefficient with the unit of humidity as a driving force. Ackermann<sup>6</sup> has already shown that such mass transfer coefficients are in contradiction to the laws of diffusion. The rate of mass transfer is proportional to the difference in partial vapor pressures, and vapor pressure is not proportional to humidity. The errors involved are rela-

tively small for dilute gas-vapor mixtures, but may become substantial in case of more concentrated mixtures.

Moreover, the method is applicable only for dilute mixtures of gases and vapors for which  $h/K_s = s$ , as is approximately correct for the system air-water vapor. For all other cases, the enthalpy method should not be applicable.

(In a second part of this article, to appear in an early issue, this design method will be shown in use through the complete calculation of an actual condenser.—Editor.)

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#### NEXT TIME, USE STATISTICS

Continued from page 222

that the within-batch variation has changed significantly and the assumption of homogeneity within batches no longer holds.

This is a difficult assumption to adhere to in practice. In manufacturing superphosphate by the Oberphos process the acid and phosphate rock dust are forced into an autoclave through a mixing valve. Owing to pressure variation and an inherent inadequacy of the mixing valve some portions of the batch are better acidulated than others. During mixing in the autoclave, if the initial reaction does not come to completion fast the product is not homogeneous.

If segregation is prevalent random sampling does not reflect a constant within-batch variation. This condition is illustrated in Period B of the control chart for excess acid in superphosphate.

Since the control limits for the averages, or  $X_m$ , are based on the mean range,  $R_m$ , the ranges must have stability. If factors within the batch are uncontrolled, then the averages

will have a greater variation even though the factors among the batches have not changed. The averages plotted in Period B seem to draw some attention to disturbances in the process. The object of the quality control chart is to indicate when factors among batches have changed. The condition in Period B is caused by changing within-batch factors and cannot be attributed to changing conditions among batches. Under these conditions the control chart is not applicable.

Notwithstanding this, however, where would an investigation begin if a significant batch-to-batch difference existed in excess acid? Is the weighing mechanism in good order? Is the pressure system leaking? What about the mixing valve and the rock grinding system? If all of these must be investigated it means loss of production, and only one may be the cause. Perhaps the trouble is something else entirely. The quality control chart, therefore, has not indicated the cause of the trouble.

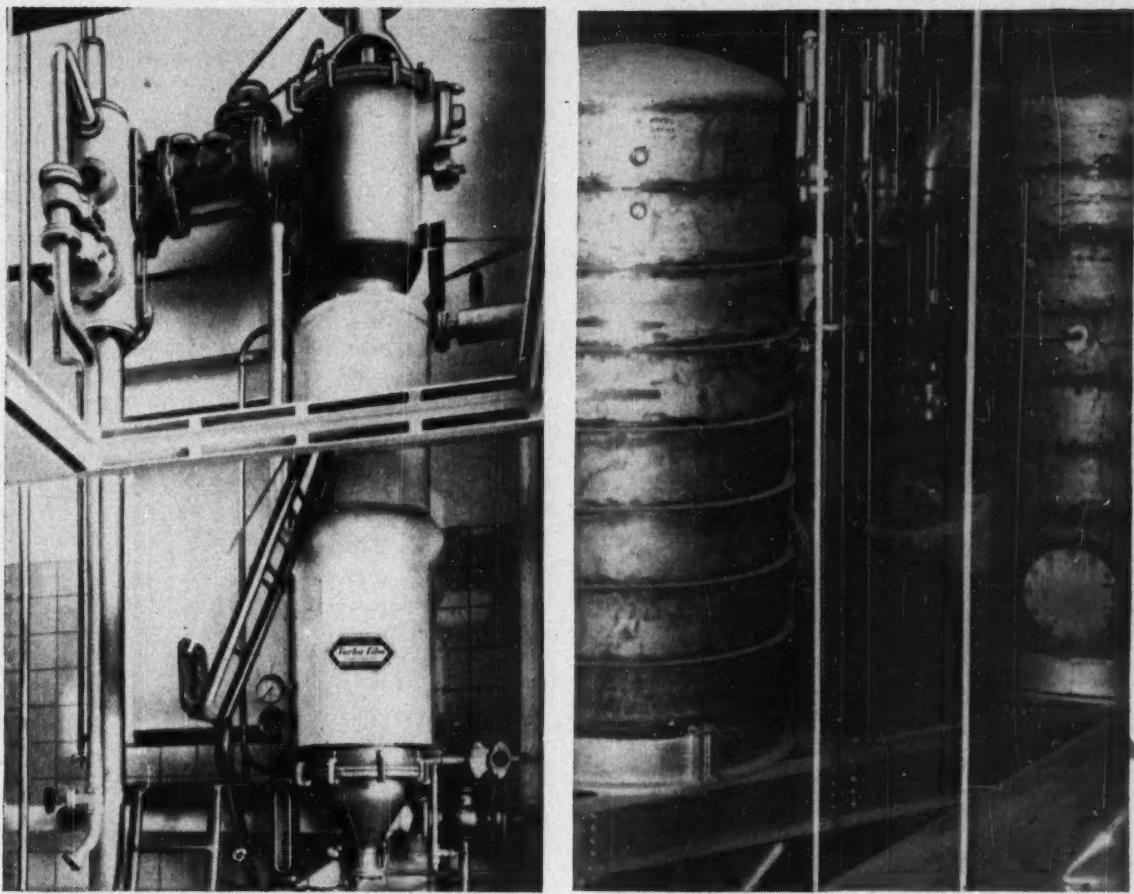
Another difficulty here is that superphosphate chemical analyses take time, and a delay of several days is not uncommon before information is reported to production management.

This is not a very satisfactory control arrangement.

In chemical processes many factors must be taken into consideration, and the control charts must be applied very carefully if they are to be of any real value. For example, a chart on phosphate rock grit is useful. Grit analysis is not a difficult laboratory task and takes little time. Trends can be detected soon enough to prevent serious consequences. The machine adjustment is simple and does not ordinarily hold up production. An application such as this does not overtax the capabilities of the quality control chart.

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NEWER TYPES of evaporators include the Turbo-Film (left) and the Conkey or Rosenblad switching evaporator (right).

# EVAPORATION

This report will serve as a valuable guide in solving your evaporation problem. It will enable you to define the problem and evaluate the various recommendations you receive from manufacturers. Besides the standard types, this report also covers the newer evaporators and reviews the energy-saving methods.

**CHEMICAL ENGINEERING REPORT—APRIL 1953**

**ERNEST LINDSEY**

UNLESS your firm has experts in evaporator design, chances are you will take your evaporation problem to as many different evaporator manufacturers as you reasonably can.

This report will help you in defining your

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problem and in evaluating the answers you will receive.

It will not be of much help in solving specific evaporation problems. While the trouble is partly that evaporation is empirical and a lot of the information is available only in manufacturers files, it is also true that there are a wide variety of problems and solutions. Each problem is affected by a lot of variables and must be

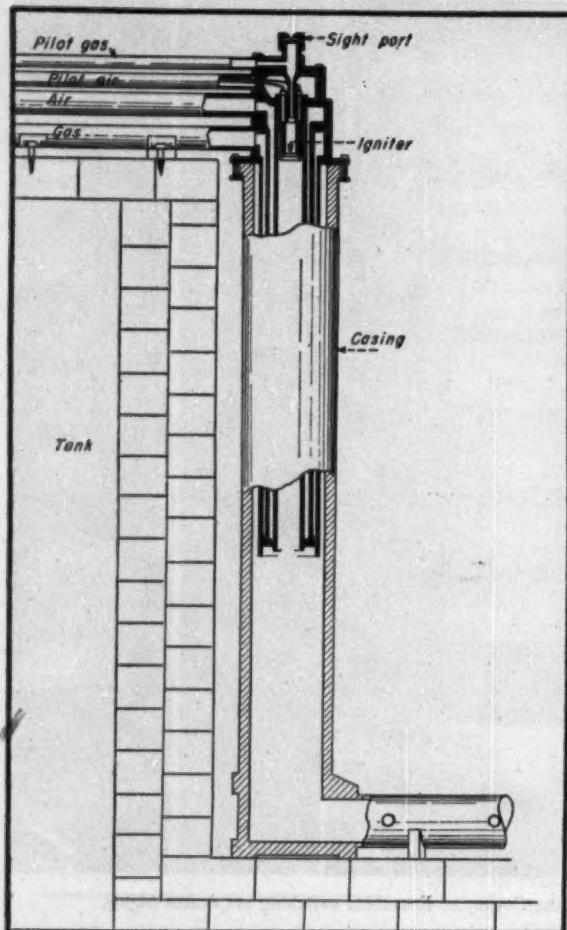


Fig. 1—Submerged combustion. (Submerged Combustion Co.)

treated individually. The best solution depends on the local conditions—properties of material, plant heat balance, cost and availability of utilities like power, steam and cooling water.

Tests will be necessary without doubt. If the material changes with storage and handling these tests should preferably be run right in your plant. Obviously tests on a perishable food, for example, are no good if the food is shipped back and forth in unrefrigerated drums, and days or weeks elapse between the time the material goes out, the tests are made, and product samples are received for evaluation.

#### A Unit Operation

*One of several* Evaporation is only one of several unit operations where vaporization takes place. Drying, distillation, stripping, humidification, and sublimation are others. Here are the usual definitions of these related operations:

Drying: removal of a liquid from a relatively large quantity of solid;

Distillation: separation of two volatile liquids, although the vaporization and recovery of water from sea salt is commonly called distillation;

Stripping: removal of a volatile liquid from solution in a practically non-volatile liquid by contact with a vapor or gas—the reverse of absorption;

Humidification: addition of water or other volatile liquid to air or non-condensable gas by direct contact;

Sublimation: vaporization from a solid;

Evaporation: removal of vapor (solvent) from a relative non-volatile solute, which is usually a solid. Usually, the solvent is not completely removed and the concentrated product remains a liquid, although sometimes a very viscous one. One exception is the case of glycerine-water solutions where the volatility of the former relative to water is so small it can be separated in conventional evaporation equipment; thus we talk of glycerine evaporators rather than glycerine stills.

*Definition of evaporation*

#### Scope of this Report

Several excellent books have been written on the subject of evaporation<sup>1, 2</sup>. In this report we'll make these limitations:

1. To the meaning of evaporation as stated above;
2. To where heat is transferred to a boiling liquid through solid retaining walls, although other related types will be mentioned;
3. Mainly to where the heat is supplied by the condensation of a vapor on these walls, e.g. steam, Dowtherm;
4. Mainly to the types of equipment most used today or to those which have recently come into commercial use.

#### Other Methods of Evaporation

Solar evaporation is done in large, shallow ponds, with heat supplied by radiation from the sun. A large installation in the San Francisco Bay area<sup>3</sup> is witness to the fact that this type of evaporation is still commercially important.

Direct-fired pans have been commonly used, but are seldom seen today outside of small installations in rural areas for making maple and sorghum syrup.

Jacketed kettles are still used—particularly where small batches are handled or where extremely viscous materials are being evaporated. For example, until a year or two ago, most candy cooking and evaporating was carried out in mechanical or hand-agitated kettles. These are being replaced by equipment using continuous processing methods. Heat transfer coefficients and details of construction are given by Badger<sup>4</sup>. Coefficients are extremely variable.

The Porron evaporator consists of rotating *Porron evaporator* discs which are alternately immersed in a pool of the liquid and in a current of hot gases. The liquid is exposed in a thin film to the gases at a high temperature and evaporation is rapid.

The submerged combustion evaporator<sup>5</sup> uses the burning of a flame under the surface of the

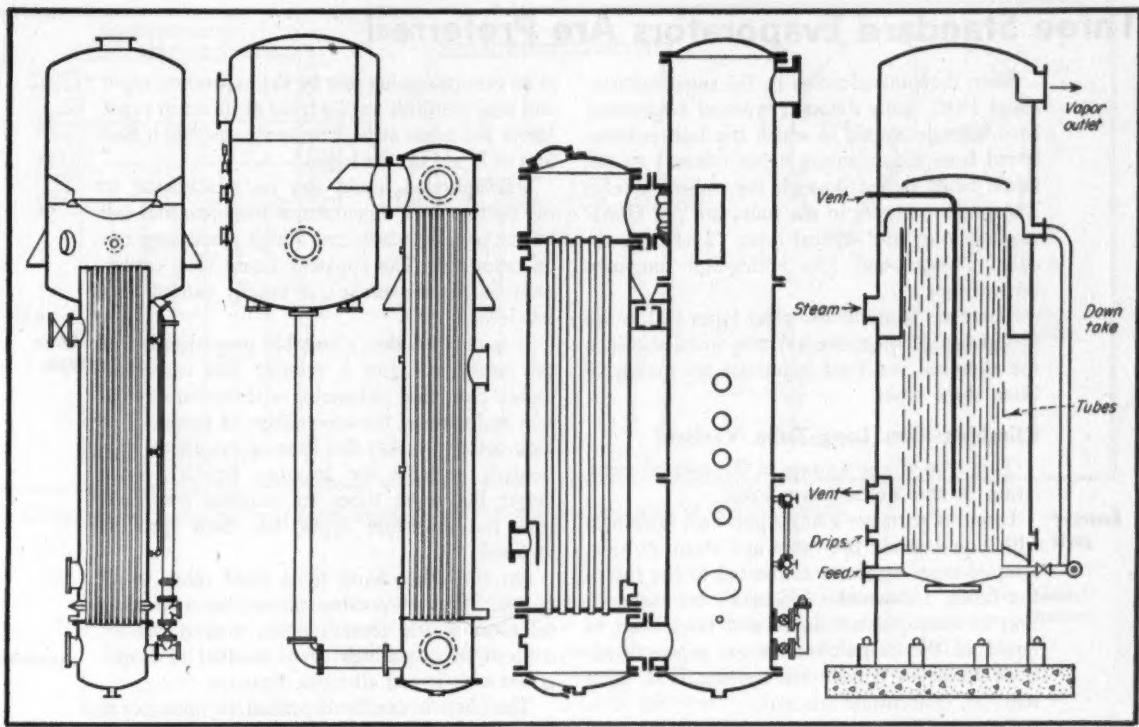


Fig. 2—Climbing-film, long-tube vertical evaporators (Zaremba-2a, 2b; Bufovak-2c; General American Transportation-2d).

liquid for heating. Heat transfer is, of course, by radiation and direct contact of fine bubbles of hot gases with the liquid. The gases can cause a partial pressure effect which lowers the temperature of evaporation. For example, pure water under atmospheric pressure will evaporate at around 90 deg. C. The thermal efficiency is around 95 percent, based on gross heating value of the fuel. For this reason the cost, even though it burns gas, is claimed to be competitive with direct-fired vessels using less expensive fuels and with tubular multiple-effect evaporators using cheap byproduct steam.

**Submerged combustion** Fig. 1 shows the simplicity of a submerged combustion installation. Careful burner design and a control system are necessary to avoid explosions. Burners are built with rated capacities of 30,000 to 5 million Btu. per hr. Several can be operated in parallel in one tank. Because of the high rate of heat release in a small volume, you can afford to use expensive corrosion resistant materials of construction.

One disadvantage of submerged combustion is the difficulty of condensing the vapors, should their recovery be desirable, due to their mixture in a large volume of flue gas. It would appear that charring and decomposition due to the intense heat would be a problem. But it is claimed that this does not occur except for a few solutions, as long as the liquid level line is above the burner plate. This method has been applied to the concentration of inorganic solu-

tions (notably strong acids, like phosphoric and sulphuric), and in general those of very corrosive nature. It is also used in the dehydration of Glauber's salt, and with sulphite waste liquor where scaling troubles exist in other types. The makers claim that "scale does not form on a bubble."

Recently a pilot plant evaporator for sulphite waste liquor was described where electrical energy was released in the solution itself due to its own resistance between electrodes\*. It is claimed that by using secondary power and by generating vapor at 80 psig. for byproduct steam, the costs are favorable in comparison with other methods of doing this difficult but increasingly more necessary job.

*Use of electrical energy*

### Basic Considerations

These problems are basic in any evaporation process:

1. To supply the heat necessary: sensible, latent, heat of solution (or more properly dissolution), and heat of crystallization. The last two are sometimes improperly omitted in heat balance and coefficient calculations.
2. To separate the vapor from the concentrate.
3. To remove these separately.
4. To minimize (usually) any chemical change, thermal decomposition, or growth of organisms that might tend to occur simultaneously.

# Three Standard Evaporators Are Preferred

Since their introduction in the sugar industry about 1840, many different types of evaporators have been developed in which the heat is transferred from a condensing vapor (steam) to the liquid being boiled through the wall of a tube. The preferred types in use today are (1) climbing-film long-tube vertical type, (2) forced circulation type, and (3) falling-film long-tube vertical type.

There are many of the older types still in use and giving good service but new installations in the chemical and food industries are mainly of these three types.

## Climbing-Film Long-Tube Vertical

This type is also known as the natural circulation or the Kestner evaporator.

### Essential parts

Essential parts are a single-pass heat exchanger with liquid inside the tubes and steam outside; a liquid-vapor separator connected to the top of the tubes; a downtake (optional) for recirculation of unevaporated liquid and for storage of liquid in the evaporator; various pipe connections for steam, condensate, venting, feed, vapor removal, concentrate removal.

Several different variations of this type are shown in Fig. 2 (a) through (d). Feed enters at the bottom under the heat exchanger tubes and under enough head to enter the lower part of the tubes; it travels upward through them, attaining a high outlet velocity due to the pumping action of the vapor generator.

Exact mechanism of vaporization is not known, but it is believed there may be three zones in the tube: (1) the lowest, where the tube is completely filled with liquid and heat is transferred by convection; (2) an intermediate zone where bubbles of vapor begin to form and grow until they trap slugs of liquid; (3) the third and highest, where these slugs are pushed

at an ever-increasing rate by the expanding vapor and may diminish until a spray of liquid in vapor leaves the tubes at high velocity, carrying a thin film of liquid up the tubes.

Unevaporated liquid can be recirculated to the bottom by a downtake or the operation can be one-pass, in which case a high percentage can be vaporized. The apparent liquid level (measured in the downtake) is usually carried at a low level.

It is claimed that a suitable proportioning of the tubes will give a velocity and coefficient higher than that obtainable with forced circulation and without the expenditure of power. The high velocity makes this type of evaporator particularly suitable for foaming liquids. Since longer but fewer tubes are required compared with the short-tube types, less floor space is required.

On the other hand more head room is required. This evaporator cannot be used with solutions which form crystals, and it cannot concentrate to as high solids content as evaporators with forced circulation can.

The shell is usually expanded at some point to provide a passage to aid steam distribution. The tendency in more recent designs is toward elimination of expansion joints in the shell.

This type is the workhorse of the chemical industry. Its uses are many and varied. A few examples: pharmaceuticals, milk, gelatin and glycerin.

## Forced-Circulation

Essential parts are heat exchanger (steam chest); a circulating pump; a vapor-liquid separator; interconnecting piping; the usual connections for steam, vapor and feed.

### Essential parts

Usually the heat exchanger is of one of two types: (1) horizontal tube, steam outside tubes, two liquid passes inside tubes, as shown in Fig. 3 (a), or (2) vertical tubes, steam outside tubes, one liquid pass rising inside tubes as shown in Fig. 3 (b).

### Method of operation

The pump forces the liquid into the tube at velocities as high as 15 ft. per sec. The liquid level is kept high so the tubes run full. This hydrostatic head, together with the pressure imparted by the pump, tends to suppress boiling in the heat exchanger so that most of the boiling takes place by flashing in the separator.

The rate of circulation is high; or to put it another way, the liquid makes many passes through the exchanger.

The mechanism of heat transfer is mainly by superheating the liquid. Consequently for design purposes the liquid-film coefficient can be predicted by the Dittus-Boelter equation for heating—forming the basis for the overall coefficient which is used with the net temperature drop in estimating heating area. Actually, the

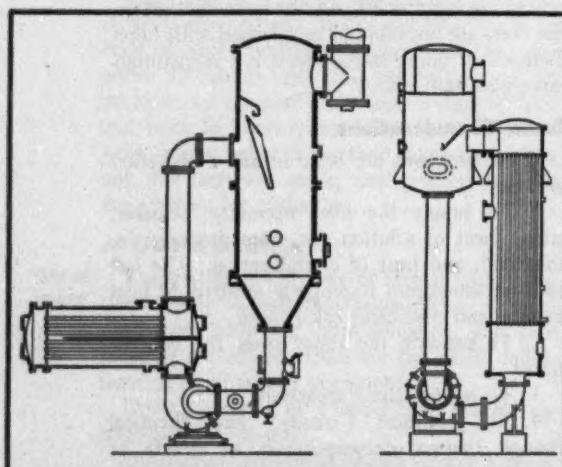


Fig. 3—Forced circulation evaporators (Buflovak-3a, Zaremba-3b).

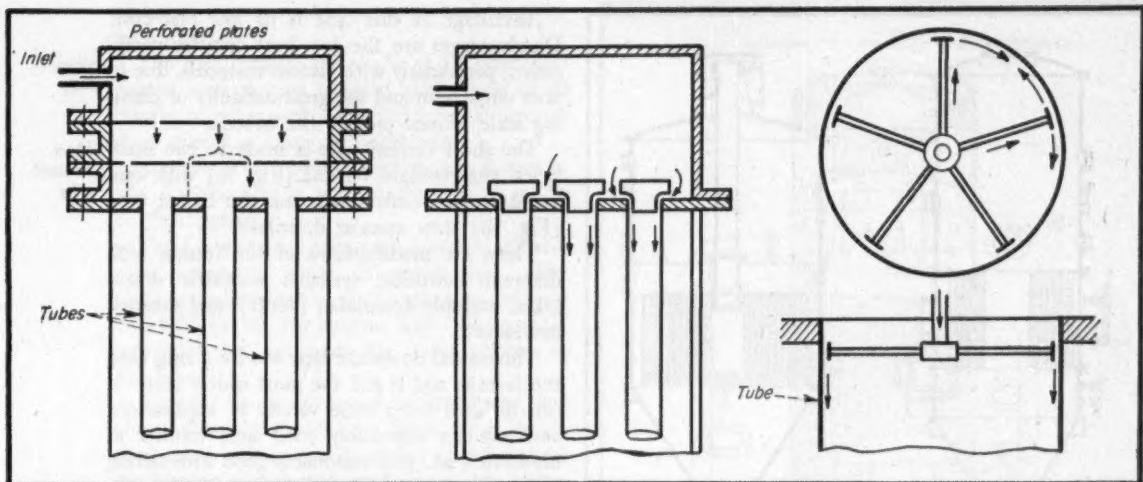


Fig. 4—Three ways of obtaining good liquid distribution with falling-film, long-tube vertical evaporators.

true  $\Delta t$  is somewhat lower and the coefficient higher, two errors which almost compensate.

**Advantages** The high velocity promotes higher rates of heat transfer per unit area. In many cases the high velocity minimizes the formation of scale. The reduced heat transfer area requirement over natural circulation may make possible the economical use of expensive corrosion-resistant materials.

Wall temperatures are lower, causing less decomposition of heat-sensitive materials. This type of evaporator can produce more viscous (or more concentrated) products. Since it does not depend on temperature difference for circulation, it allows lower  $\Delta t$ 's to be used. This is a help with heat-sensitive materials. It may also allow a greater number of effects to be used in a multiple-effect system, thus saving on steam.

One big disadvantage is the extra costs of the pump and of the power required. Holdup of liquid is greater, which means that material is held in the evaporator longer—a disadvantage in the case of heat-sensitive materials.

#### Falling-Film, Long-Tube Vertical

Essential parts are a heat exchanger (single-pass vertical tubes), a liquid distributor for putting feed on the tubes, a separator, connections.

**Method of operation** Feed enters the top of the vertical tubes which are 2 to 10 in. inside diameter. It is placed on the inside of the tubes as a thin film and runs down the tubes in this manner, being heated and boiled by steam on the outside.

Flow rate is adjusted so it is at the desired concentration when it reaches the bottom. Usually the liquid and vapor flow concurrently to the separator, although some evaporators (such as the Skinner) use countercurrent flow of liquid and vapor, with separator and feed distributor at the top.

Good liquid distribution on the tubes is obvi-

ously important (Fig. 4). One way to get this **Special features** is to have two or more horizontal perforated plates above the top ends of the tubes. The top ends of the tubes in the tube sheet must be smooth and level.

A second method uses an insert in the ends of the tubes to create a weir effect around the tube.

A third uses individual spray nozzles.

A fourth forces the feed under pressure through a "crows foot" or "spider" distributor directly on the tube.

For good heat transfer, it is desirable that the value of the modified Reynolds Number of liquid in the tubes ( $4\Gamma/\mu$ ) should be 2,000 or higher, where

$\Gamma$  = liquor flow in pounds mass per hour per linear foot of wetted perimeter,

$\mu$  = viscosity of the liquid in pounds mass per hour  $\times$  feet.

Length/diameter ratio for the tubes is best designed for a particular operation. Minimum concentration ratio in the feed may be limited by flooding of the tubes. The maximum concentration ratio is definitely limited by the minimum amount of liquid flow you can have in the lower section and avoid sticking and buildup of material on the tubes.

This difficulty with flow rates can often be helped by "cascade" or "multiple pass" operation of the liquid through several tubes in one body. Liquid flows down through one tube, is lifted back up by a pump, flows down another tube, and so on. Usually it is a series-parallel arrangement with the number of parallel tubes in one series step decreasing as the liquid becomes more concentrated. This is one of the features of the Skinner evaporator for citrus juice (Fig. 10).

Big use is in the frozen orange juice concentrate industry. Probably around 50 million gal-

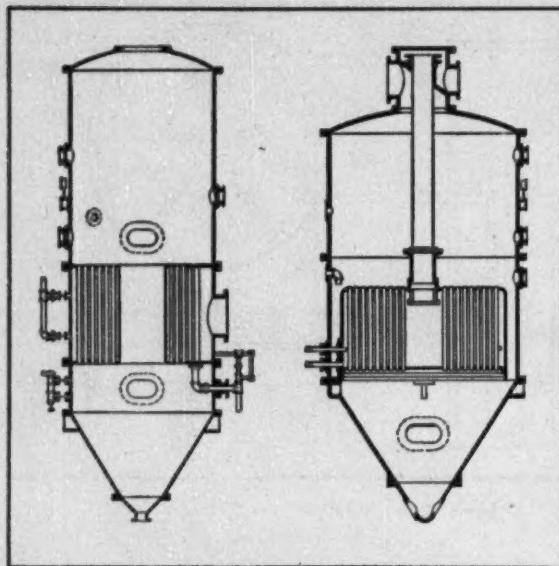


Fig. 5—Types of short vertical tube evaporators (Zaremba).

lons of frozen concentrated juice (4:1, by volume) will be produced this year in this type of evaporator body.

Orange juice is probably one of the most heat-sensitive materials. Incidentally, the juice is actually evaporated to about 5:1 and then cut back equivalent to 4:1 with fresh juice to give it flavor.

**Advantages** Essential advantages are low holdup and higher liquid velocities in one pass over the heating surface. The low time in process and higher liquid film heat transfer coefficients make it very good with heat sensitive materials. It can produce higher concentrations (higher viscosities) than vertical tube climbing-film types. These characteristics make it useful for viscous and/or heat-sensitive materials.

Disadvantages of this type evaporator are the liquid distribution problems mentioned.

#### Other Types

Among the other types are the horizontal-tube, the short vertical-tube, the coiled-tube and crystallizing evaporators.

**Horizontal tube** First real steam-heated evaporator was a horizontal tube type by Rillieux about 1840. A number of this type are still in use today. Present design with steam inside the tubes dates back about 50 years.

## Newer Evaporators Solve Special Problems

The newer types include the Turba-film, flashing evaporators and the Conkey (Rosenblad) switching evaporator.

#### "Turba-film" Evaporator

The "Turba-film" evaporator is an agitated

Advantage of this type is its low first cost. Disadvantages are the low heat transfer coefficients, particularly with viscous materials, due to poor circulation and the great difficulty of cleaning scale formed outside the tubes.

The short vertical tube is made in two main types: the standard vertical (Fig. 5a) with central downtake (calandria), and the basket type (Fig. 5b) with annular downtake. Short vertical tube

There are modifications of the former with different downtake systems: eccentric downtakes, multiple downtakes (Scott), and external downtakes.

The central downtake type was for a long time the favorite and is still the most widely used. It can be used for a wide variety of applications and provides reasonably good heat transfer at moderate cost. It is reasonably good with salting and scaling liquids. The tubes can be fairly easily cleaned inside. It cannot handle liquids of high viscosity.

A few types use steam inside a submerged coil tube. Some with large heating area are used for production of boiler feed. Coiled tube

This type is frequently used in batch operation where limited volumes of product are made or where fairly viscous products are made. In the sugar industry it is known as the "finishing pan" or "strike pan." It is widely used in evaporating milk and other dairy products where it is known as the "vacuum pan". The one shown in Fig. 6 has a built-in countercurrent spray condenser.

Evaporation and crystallization often occur simultaneously in the same piece of equipment. Some evaporation may occur in crystallizers, particularly flash evaporation under vacuum, and vice versa in evaporators. Crystallizing

Several types of evaporation equipment are adapted to crystallizing service. Very common is the standard vertical (calandria) type equipped with a propeller in the central downtake for accelerating circulation. Forced circulation types are used with a lower liquid velocity to minimize erosion, and frequently run submerged to minimize boiling in the tubes. The natural circulation type is sometimes used.

Preferred method of removing crystals seems to be to remove a suspension from the evaporator, classify, and return the mother liquor with fine crystals to the evaporator.

The inclined-tube evaporator, once made by Bullova, had no particular advantages and is no longer listed in their catalog<sup>1</sup>.

falling-film unit invented in Switzerland by Hans Muller of the Nestle Milk Chocolate Co. and developed by the Luwa S. A. of that country. It was introduced in this country early in 1951 by the Rodney Hunt Machine Co. The general principle is to produce turbulence in a thin layer

of liquid over the entire area of the heat transfer surface.

**Essential parts** The unit consists essentially of an externally-heated vertical tube jacketed along most of its length, together with a central internal agitator shaft extending along its entire axis.

A cutaway view of a typical unit is shown in Fig. 7. Numbers in parentheses refer to points on the diagram.

There is a vertical tube with a central agitator shaft extending along its entire axis. The blades attached to this shaft extend to between 0.03-0.06 in. of the heating wall. An external heating jacket surrounds the lower portion of the tube.

Material to be processed is introduced just above this jacket. It then flows down inside the heated wall by gravity and is spread against the heating surface and kept as a highly turbulent thin film by the rotating agitator blades, during which time boiling takes place. The concentrate emerges from the bottom outlet which in some cases is conical.

#### Entrainment separator

The upper part of the evaporator (not jacketed) is expanded to contain an integral entrainment separator. The agitator blades extend into this section. Their centrifugal action throws any liquid droplets against the stationary fins where they coalesce and return to the heating zone for evaporation. This separator takes care of froth. Carryover of foam and entrainment is negligible except with products that produce an extremely stable froth or at excessive vapor rates.

At the top of the evaporator there is a flooded mechanical shaft seal. Some units built for high temperature service with high-boiling organic compounds use double seals and external bearings. The top bearing, thrust and radial, is of the ball or roller type. The bottom bearing, which is of the carbon impregnated type, usually is inside the evaporator and designed so as to be free of contamination by the material being processed.

**Instruments** Instruments operating on the boiling-point rise principle can smoothly and accurately control the composition of the product. Control can be accomplished by other instruments operating

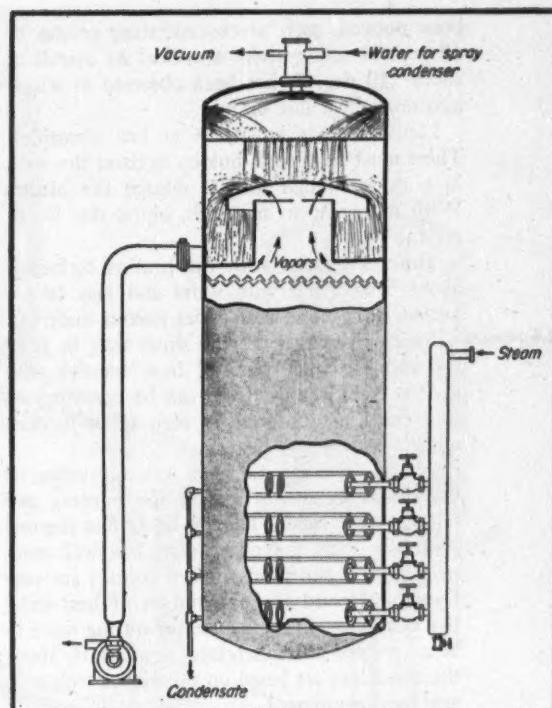


Fig. 6—Typical vacuum pan (Mojonnier Bros.).

on density, viscosity, or other properties. Some European installations operating to produce extremely thick products have a screw feeder between evaporator outlet and pump intake.

Generally any material which can be pumped following concentration can be processed satisfactorily. Products have been made with viscosities as high as 100,000 centipoises at evaporator temperature.

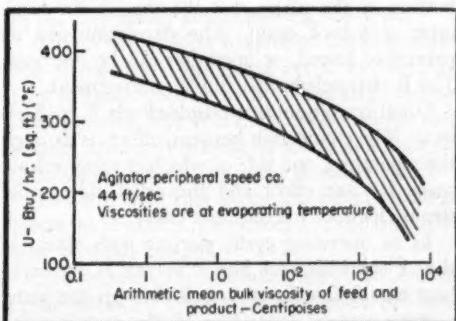
Evaporation rates and "U" values decrease with viscosity, but not nearly so much as is the case with conventional evaporators. Drawing shows effect of viscosity on U when concentrating aqueous solutions with Newtonian characteristics. U values in the high viscosity range are quite an improvement over even the forced circulation type. Thixotropic materials will show U values above the band shown based on apparent viscosities measured with conventional instruments. Because of the high rates of shear, in some cases, the product leaving the bottom of the evaporator is quite fluid but after standing for a short time without appreciable decrease in temperature, it will become brick-hard.

Agitator speed has an important effect on heat transfer. U values increase with speed within the limits set by the condensing steam film and wall resistance to heat transfer. Normally the peripheral speed of the agitator blades is about 44 ft./sec. Usually it is reduced when handling higher viscosities.

Temperature difference ( $\Delta t$ ) usually has no influence on U value. Some exceptions have

Per-formance

Effect of agitator speed



Viscosity vs. U—Newtonian aqueous solutions.

been noticed, such as concentrating gelatin to 40 percent solids where a critical  $\Delta t$  overall of about 110 deg. F. has been observed at which maximum heat flux occurs.

Liquid rate is important at low viscosities. There must be enough holdup to cover the walls in a thick enough film to engage the blades. With more viscous materials, liquid rate is not critical.

Time of contact with the heating surface is about 5 to 7 sec. with water and may be expected to be more with more viscous materials.

**Advantages** Main advantages are the short time in process and the high rates of heat transfer with viscous materials. Material can be concentrated in a continuous process to high solids content quickly and in one pass.

The positive agitation and scouring action of the blades minimizes scaling and burning and salting on the tubes. The low liquid film thermal resistance with the consequent low wall temperature and the short time of contact are very favorable toward the evaporation of heat-sensitive materials—in some cases permitting these to be evaporated at temperatures significantly above the maximum set based on experience with conventional equipment.

For example, 70 deg. F. was believed to be the upper limit for concentrating a particular vitamin, but this has been concentrated in the Turba-film at temperatures of 125 deg. F. and higher without loss of quality.

Other advantages claimed for it are the short time required for starting up and shutting down and the relative ease of cleaning and maintaining sanitation.

**Dis-advantages** Principal disadvantage is in the high initial cost (\$7,000 to about \$20,000 for bodies alone in 316 stainless steel) due to the construction and to the close machining required. Another is small capacity. The largest single unit has only 66 sq. ft. of heating surface which makes its size and capacity far below that of some large multitubular evaporators. Another is that it requires internal moving parts.

The construction for vacuum evaporation requires that the heat be transmitted through relatively thick walls. For example, in evaporating water in one of 10 in. inside diameter with 0.11 in. walls of 316 stainless, the wall resistance is about one-third of the total. As a result, the  $U$  values of about 400 obtained with water are inferior even to those in the long-tube evaporators: climbing-film, falling-film, or natural circulation.

**Applications** It will probably find its main application as a finishing evaporator operating in the higher viscosity ranges, and for evaporating heat-sensitive or delicate materials. It will supplement existing evaporator types rather than replace them. It will be used to reduce the load on drying equipment.

Successful applications include such materials

as caramel candy, coffee extracts, gelatin, antibiotics, vitamins, rubber latices, and fruit juices. It has also been applied to vacuum steam stripping (deodorization) of fats and oils.

### Flashing Evaporators

There are a number of evaporators where vapor is driven off in a flashing operation under vacuum, such as the Cherry-Burrell Co. "Vacreator" and the Cornell Machine Co. "Versator." In the latter, very rapid evaporation occurs from an extremely thin film spread by centrifugal action. The latent heat of evaporation is furnished by the sensible heat of feed.

### Rosenblad Switching Evaporator

The Conkey or Rosenblad switching evaporator was developed in Sweden for evaporating scale-forming liquids, in particular, sulphite pulp waste liquor. American rights are held by the General American Transportation Co.

The evaporating and steam condensing surfaces are periodically exchanged so that the scaled surface is washed with condensate, dissolving and carrying away the scale.

Heart of the evaporator is the heat exchanger built of parallel plates for heat transfer surface. Plates are separated by suitable spacers and sealed from one another to form an enclosed channel between each pair. An odd number of plates is used to form an even number of channels.

This assembly of plates is enclosed by a reinforcing shell to provide adequate strength against any pressure conditions imposed on the equipment. Further strength is imparted by studs spotwelded across a pair of plates.

Alternate channels are connected to a common manifold at the top of the shell and another manifold at the bottom of the shell with inlet and outlet nozzles for steam and condensate. Let's call these the A channels. The remaining channels would be connected to common manifolds at the top and bottom, and we'll call them the B channels. The A channels are connected to one-half an entrainment separator made up of a large chamber with vertical partitions divided by extending from the bottom almost to the top. This provides for circulation of liquor in the bottom of the plates, out the top, to the separator, and back again. The circulation can be natural or forced, or operation can be one pass. The B channels have a similar arrangement.

Usual operation is multiple-effect, 4 to 8 effects. The connection between effects is through the separators, one side of which is vapor release space for one effect and the other side is the steam chamber for the next effect.

In an operating cycle, starting with steam in the A channels and liquor in the B channels, heat would flow from A to B through the plate.

After a time, depending on the scale-forming properties of the liquor, the unit is shut down

*Essential parts*

*Operation*

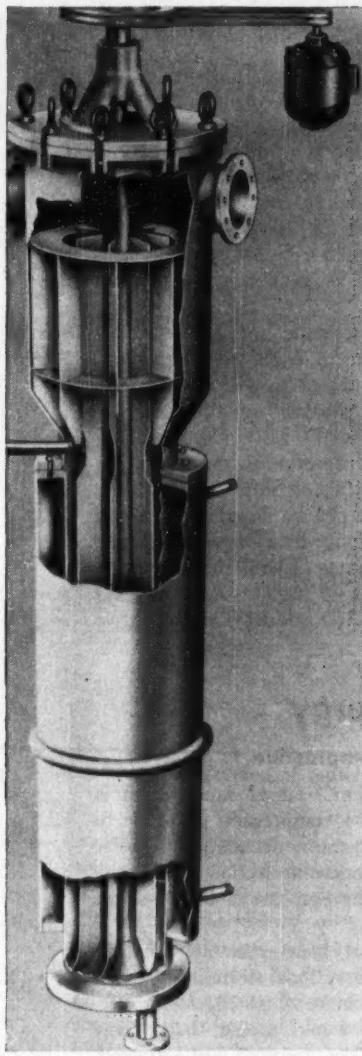


Fig. 7—Cutaway view of Turba-Film.

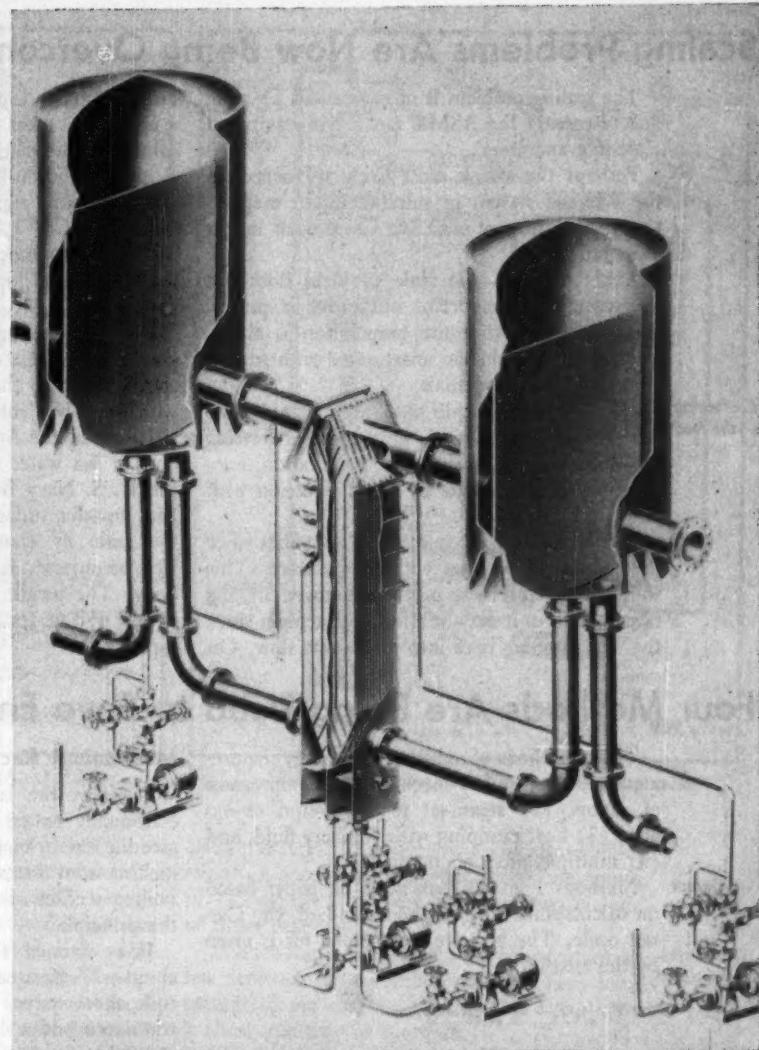


Fig. 8—Cutaway view of a Rosenblad switching evaporator.

for a brief period during which liquor is transferred from B to A channels. Valves are switched so the steam condensing is in B and liquor boiling is in A, with heat flow from B to A through the plate.

Additional condensate is added with the steam to aid in washing and dissolving the scale.

After a while, there is another brief shutdown and changeover ending the cycle, so that heat flow is again from A to B. Thus each channel is evaporating half the time during which scale is built up and is serving as steam side half the time during which the scale is dissolved.

You will note that when the switch is made, the order of effects is reversed, i.e., the first effect now becomes the last.

**Performance** The manufacturers state that heat transfer coefficients and efficiencies are about the same as with tubular evaporators under comparable conditions (temperature, solids, velocities, etc.).

Costs are rather high due to the number of valves required for switching, the fact that half the separator is idle when used on the steam side, and the complicated construction of the plates and studs in the exchanger.

Rosenblad<sup>6</sup> gives some installed costs on units with sulphite waste concentrating from 9.15 percent solids feed to 49.56 percent product, with 11 and 50 percent respectively as average values:

Evaporation, Lb./Hr.	Installed Cost 4-effect	Installed Cost 6-effect
50,000	\$210,000	
100,000	\$340,000	\$370,000

A number of these are reported in operation on sulphite waste liquor in Canada and in Wisconsin. The product is burned in boilers as fuel. The economics are said to be marginal, but it does give a solution to a difficult and pressing waste disposal problem, which in itself is significant.

## Scaling Problems Are Now Being Overcome

The scaling problem is of course still a vexing one. Recently the ASME ran a symposium on scale in evaporators<sup>2</sup>.

Perhaps the attack most likely to succeed is the Ramen<sup>®</sup> system in sulphite liquor evaporation or the International Salt Co. process in salt evaporation<sup>1</sup>.

This attack on the scale problem does not involve a new evaporator but rather a process modification so that the evaporation is always operating on a solution unsaturated with respect to scale-forming materials.

### Preheating the feed

For  $\text{CaSO}_4$  (or scale with an inverted solubility-temperature curve), it involves preheating the feed to well above the evaporation temperature under pressure by direct injection with steam.

Some  $\text{CaSO}_4$  is precipitated as anhydrite since the solubility decreases with temperature. This solid, as fine crystals, may be removed by the usual means or it may be allowed to remain since the rate of going back into solution is slow. On

introduction to the evaporator it flash cools and evaporation takes place from an unsaturated solution without scaling the surface.

As the solution becomes more concentrated in the evaporator and approaches saturation with respect to  $\text{CaSO}_4$ , it may again be heated up with steam to knock out  $\text{CaSO}_4$ . Since the heating up is not done by a surface, there is no scaling.

Sea water scaling seems to be fairly well taken care of by a mixture of boiler compound and starch added to the liquor to give a fluffy scale which can be "cold shocked" off the tubes.

### Other methods

However, the Arthur D. Little Co. has developed a sea water recompression evaporator for the U. S. Navy Bureau of Ships in which the heat transfer surface can be flexed to break off the scale by changing the internal pressure. The compressor is integral with the evaporator body. The height is 46 in., O. D. 22 in., and weight 450 lb. for a 300 gal. per day evaporative capacity.

## Four Methods Are Being Used to Save Energy

These methods of reducing the energy requirement are in use: (1) mechanical recompression of vapors, (2) steam-jet recompression of vapors, (3) heat pumping with auxiliary fluid, and (4) multiple effect operation.

### Carnot cycle

Methods 1 and 3 look good on paper based on calculations using as their standard, the Carnot cycle. The best we could hope for is given by the relation:

$$\frac{W}{Q_1} = \frac{T_1 - T_2}{T_1} = \frac{\Delta t_{\text{evap}}}{T_1}$$

$W$  = shaft work input to Carnot system,  
 $Q_1$  = heat transferred by heating medium condensing in evaporator at  $T_1$  degrees absolute,  
 $T_2$  = temperature of evaporation.

Actually, we should base the Carnot cycle energy efficiency on the highest and lowest temperatures in the system:

$$\frac{W}{Q_1} = \frac{\Delta t_{\text{evap}} + B.P.R. + \Sigma \Delta t_{\text{exch}}}{T_1}$$

$\Delta t_{\text{evap}}$  = temperature difference available for heat transfer in evaporator.

$\Sigma \Delta t_{\text{exch}}$  = the sum of all  $\Delta t$ 's in exchange involving the auxiliary fluids.

B.P.R. = boiling point elevation in the evaporator.

Method 2, the steam jet, is subject to the same analysis—considering the motive steam as a source for an engine operating to drive the system above.

Due to friction, heat losses and other factors the actual  $W/Q_1$  ratio will be 25 to 70 percent higher.

### Mechanical Recompression

Basically, the latent heat of vaporization is continually reused by compression of vapor to give the rise in temperature necessary to transfer its heat from the condensing section back to the boiling section of the evaporator. Fig. 9 shows the principle.

It is claimed that heat economy equal to about a 27-effect conventional steam-heated multiple effect system can be obtained. With electric motor drive it would appear that energy consumption is of the order of 110-180 kwh. per M gal. water evaporated, or 13.21 kwh. per 1,000 lb.

Latham<sup>3</sup> has shown (see Fig. 11) that for typical operating conditions about 10 deg. F. is the most economical  $\Delta t$ , assuming electrical energy at \$0.01 per kwh., 15-year amortization, and a medium sized plant of 50,000 gpd.

### 10 deg. F. most economical

A big stumbling block is the compressor. The reciprocating compressor is out because of the tremendous vapor volume to be handled. The rotary positive displacement compressors (such as Roots, Lysholm, Read Standard) have worked very nicely in small and medium sized plants. Their constant displacement feature is a great advantage here because it automatically adjusts pressure (and  $\Delta t$ ) for decrease in coefficient due to scaling, up to the point of overloading the driver. Also, these compressors are claimed to aid in maintaining an even boiling which helps reduce entrainment. However, they have not yet been built in large capacities.

The field of the hydrodynamic type of compressor (centrifugal, axial flow, mixed flow) is

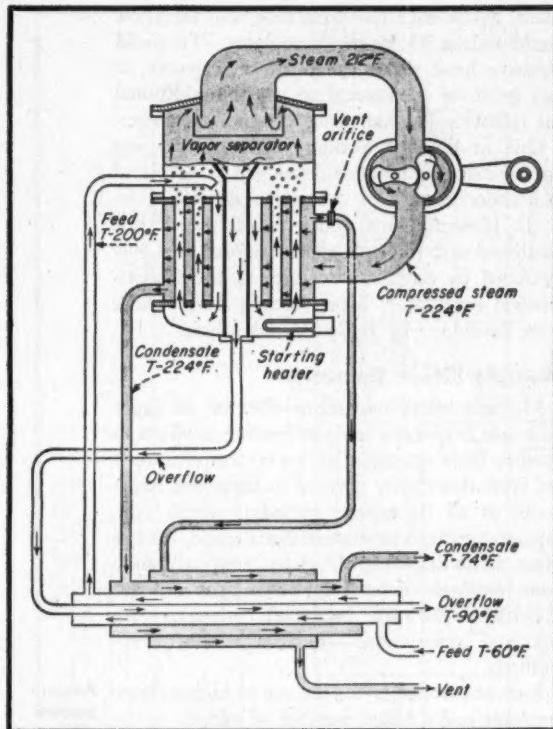


Fig. 9—Mechanical recompression of vapors (A. D. Little).

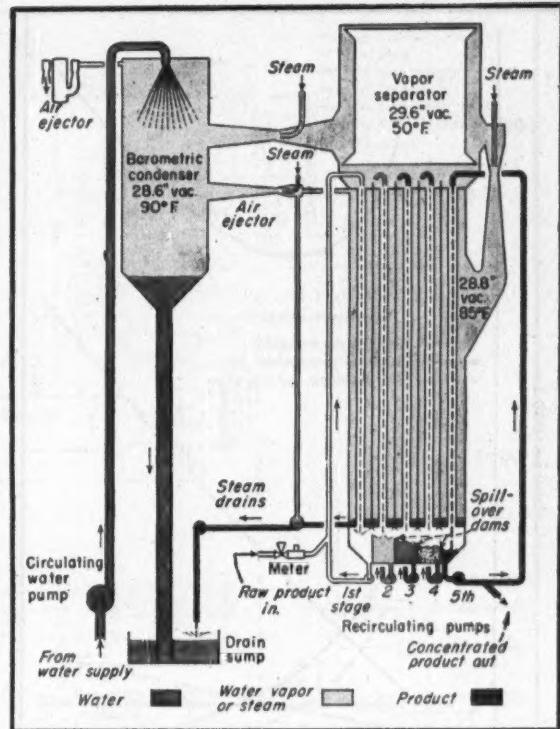


Fig. 10—Skinner falling-film jet recompression evaporator.

in large displacement with high efficiencies, but their operating characteristics are not favorable to this use. The output decreases with pressure differential and operation is unstable at low flows. If scale can be eliminated and stable operating conditions near the design point maintained, this type can be used. Large and more economical units could be built. The big use of recompression is on sea water with over 12,000 units, mostly in military service. A few units are in use in pharmaceutical plants to make distilled water. Two chemical plants use it to concentrate wastes.

Equipment of this type is put out by Badger Mfg., Cleaver-Brooks and Mechanical Equipment Co. under the A. D. Little patents.

#### Steam Jet Vapor Recompression

**Principle** Thermo-compression operates on the same principle as mechanical except a steam jet is used to compress the vapors to an intermediate pressure. Since there is now excess energy in the form of steam, some jet exhaust steam must be either vented or condensed, depending upon the pressure level. Fig. 10 shows a booster jet used to raise this excess steam up to condensing temperature.

**Steam requirement** Once the terminal conditions are set, the best method is to estimate the steam requirement from data available in the manuals of the various jet manufacturers. As you might expect, ratio of motive to entrained steam varies with oper-

ating pressures. In many low temperature applications a good rough figure is about one pound of 125 psi. motive steam for every two pounds of water evaporated.

The jet can handle large volumes of vapor at low densities. Low absolute pressures (low temperatures) are easy to obtain. The compressor is cheap and easy to maintain.

A main disadvantage is low thermal efficiency (the jet is rather inefficient). The jet is not too flexible toward changed operation conditions. It may easily "break" and cause trouble by sudden loss of vacuum.

#### Heat Pumping with Auxiliary Fluid

Heat pumping is essentially the same as mechanical compression except that heat is transferred from the vapors back to the heating by an auxiliary fluid of high density. Another name is reversed refrigeration.

In low temperature applications, the work of compression theoretically represents an excess of energy in the heat balance. Heat losses and feed requirements will consume only a part of this, necessitating removal of some heat.

An example will show the inherent strong and weak points. One pound of saturated water vapor from evaporation at 100 deg. F. has a volume of 350.4 cu. ft. If its latent heat is transferred by heat exchange to saturated liquid ammonia at say 10 deg. lower or 90 deg. F. (165.9 psig.), 2.13 lb. will be vaporized with a total

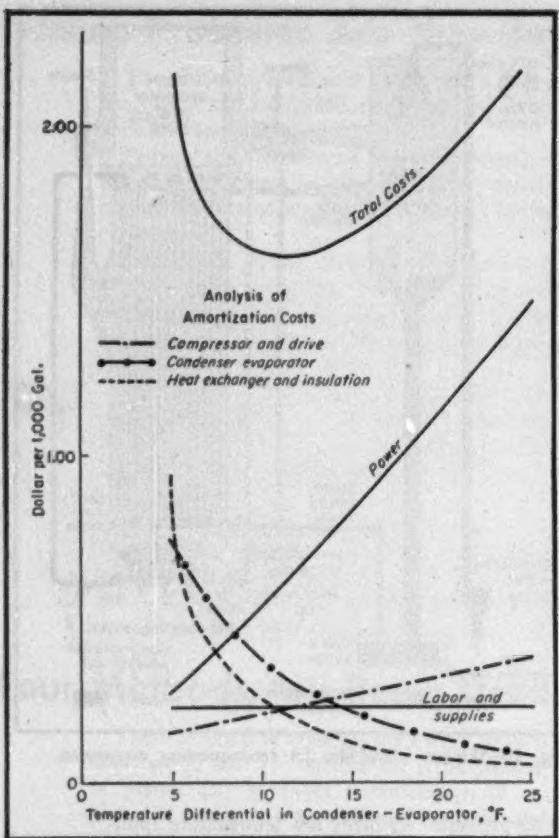


Fig. 11—Effect of temp. differential in vapor recompression.

volume of 3.53 cu. ft., or about 1 percent the volume of the steam.

Isentropic compression of the ammonia to a condensing temperature of 125 deg. F. (293 psig.) would require 68 btu. of shaft work, while isentropic compression of steam to the same condensing temperature would require 50 btu.

**Advantage** The advantage then, is the reduction in volume handled by the compressor and lines; the disadvantages are the increased power requirement of compressing the auxiliary fluid from a lower temperature (pressure) to allow for heat exchange and the increased structural complications caused by increased pressure in the evaporator shell. At lower temperature levels the reduction in volume is even more striking.

For several reasons water may be used as an intermediate fluid on both the evaporator and condenser sides:

- To avoid possible contamination of product by leakage of fluid in the evaporator;
- As a further safeguard from overheating;
- To reduce the amount of fluid (refrigerant) in the system;
- To reduce the design pressure requirements in the evaporator;
- The condensing film coefficient of most Freon type refrigerants is rather low compared to

steam, which with the extra tube wall thickness would reduce  $U$  in the evaporator. To avoid excessive head pressures or loss in capacity, it may be more economical to use the additional but relatively less expensive external exchanger.

One of the first auxiliary fluid systems was the Lo-Temp evaporator developed by Cross of Mojonier Bros. Co. A system developed by C. E. Howard Corp. which makes use of this combined with multiple effect evaporation is now produced by the Carrier Corp. as the Carrier-Howard evaporator. More recently designs have been developed by Bufovak and others.

#### Multiple-Effect Operation

Multiple effect operation—the use of vapor from one evaporator body as heating medium in another body operating at lower temperature—has been thoroughly covered in texts and handbooks in all its aspects including steam cost, apparatus costs, temperature distribution, adverse effect of boiling-point-elevation, terminal conditions, methods of feeding—advantages and disadvantages (forward, backward, mixed), venting, and calculations—including “short cut” methods.

Present practice favors the use of higher steam pressures and a larger number of effects. Present practice

#### Comparison of Heat Saving Methods

No hard and fast rules can be given on which of the four methods is best. Each case should be evaluated on its own merits considering the local conditions.

Mechanical compression and multiple effect are favored for high evaporation temperatures, with the latter still holding the edge in this country where fuel costs are low and equipment costs relatively high.

The steam jet and heat pump cycles are favored when the evaporation is at such a low temperature the vapors cannot readily be condensed with the cooling water available, and when there is an upper limit set on the heating medium temperature.

Conditions in the Florida citrus industry favor the jet and heat pump. Here cooling water runs 75-85 deg. F. Evaporation should be done about 60 deg. F.—certainly no higher than 80 deg. F.—in the falling-film type used and 104 deg. F. is about the upper safe limit of the heating medium to avoid a cooked flavor. Many citrus evaporators combine the jet or heat pump with multiple effect operation.

Schwarz<sup>18</sup> gives a cost comparison (in 1950) of jet and heat pump evaporators for orange juice, in 6,000 lb./hr. evaporative capacity when evaporating from about 11 to 50 percent solids.

A double-effect steam jet unit designed for 2.50 lb. per hr. per sq. ft. evaporation cost \$41,000 for evaporator bodies and accessories; a refrigeration (heat-pump) system designed for 1.36 lb. per hr. per sq. ft. cost \$49,000.

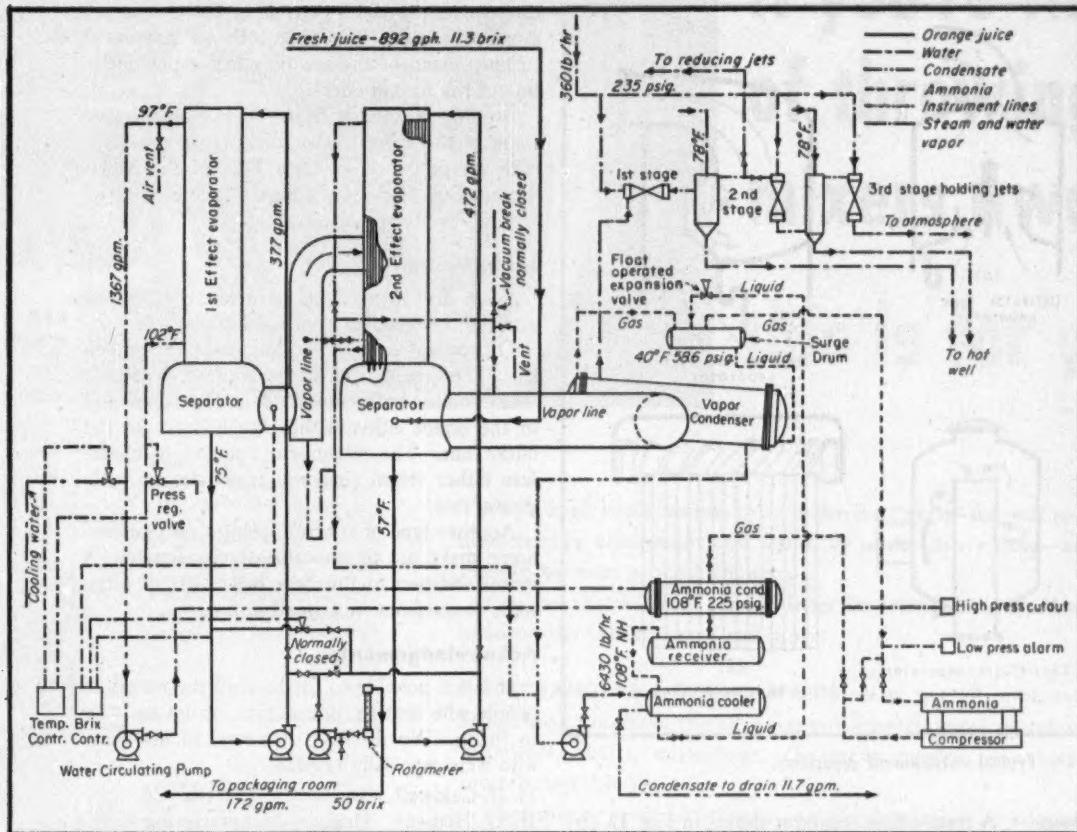


Fig. 12—Double-effect evaporator installation (6,000 lb. per hr.) with auxiliary heat-pumping fluid (Minute Maid).

The refrigeration units themselves varied from \$26,000 for a reciprocating compressor and its auxiliaries to \$42,000 for a centrifugal compressor system. The refrigeration system has U

values of about 80 and 120 btu. per hr. per sq. ft.  $\times$  °F. in first and second effects, respectively. Fig. 12 shows a flow diagram of one of the systems.

## What About Costs of Evaporators?

With so much of a variation in evaporator construction, materials and accessories, manufacturers are reluctant to give standard cost figures.

For rough estimating purposes there are some fairly reliable correlations of evaporator costs in the more common types and materials<sup>28, 27, 23</sup>.

**Most reliable method** The most reliable method seems to be to estimate the unit cost as cylindrical shells, plates, heads, tubes, fittings, etc. based on the weight of material and the unit material and labor

costs. This is the method generally used by fabricators.

There's little published on the cost of falling-film evaporators. A recent June 1952 quotation<sup>29</sup> was about \$14,000 for body alone without accessories or supports. Design pressure for shell was 150 psi., for tubes 30 psi. Vacuum was to be used; tubes were to be of 316 stainless and shell of carbon steel, 170 tubes 2 in.  $\times$  20 ft., heating area about 1,800 sq. ft. This is probably comparable with Schwarz's figures.

## Separators, New Instruments Aid Operation

Simplest type of separator, of course, is to have the vaporization into a large chamber where vapor velocity is low and height is large enough to allow droplets to fall back into the liquid.

Another simple solution is to install a deflector baffle usually over the outlet from the tubes.

Fig. 13 (a) shows a more elaborate version where vapors and droplets go through a short stack and impinge against a spring-loaded deflector head. The droplets are then deflected radially. The pressure drop maintained by the spring loading in the separator is said to aid in expanding and breaking bubbles.

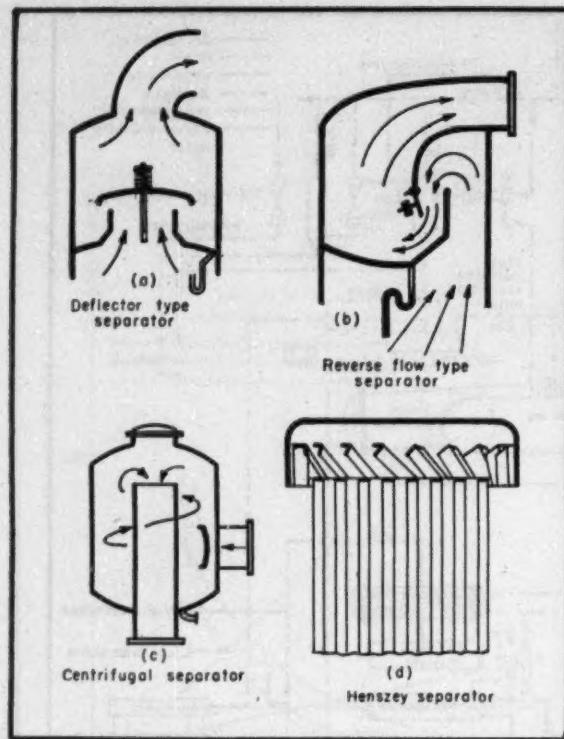


Fig. 13—Typical entrainment separators.

**Reverse flow type** A reverse flow separator shown in Fig. 13 (b) is also mounted integrally in the body. The vapor stack is mounted against the side for ease in cleaning.

Centrifugal force separates bubbles and droplets from vapor by means of a sudden reversal. Travelling downwardly the flow is automatically regulated by a counterbalanced damper, which throttles the vapor flow and maintains a uniform velocity and pressure drop. In a second reversal the vapors expand upwardly through the separator's main chamber, where droplets impinge against the bottom. Recovered liquid is returned to evaporation through a U-tube vapor seal.

Fig. 13 (c) shows the centrifugal type separator which can be designed to operate efficiently. The Flick separator is a modification of this with a horizontal spiral baffle and vertical louvers on the outside of the cylinder.

**Henszey separator** The Henszey evaporator uses a turbine type separator shown in Fig. 13 (d) in a vapor dome integral with the heating element. A detachable turbine blade ring assembly fits around the end of tube bundle. An umbrella or cap fits over this ring and the tube sheet. Material issuing from the tubes is first deflected by the cap, then given a whirling motion by the turbine ring.

This type has been applied extensively in milk evaporation where stream pollution by carryover is a serious problem. It is claimed that milk

carryover is only 0.02 percent in a double effect evaporator using this type with an additional turbine ahead of the second effect vapor outlet line of the second effect.

Another method is to use in the vapor space some of the more recent metal mesh packings, such are produced by Otto York or the Metal Textile Co. These give a high degree of removal with a low pressure drop.

#### Instruments

Some new instruments have recently become available for product composition control.

B.P.R.  
principle

One operates on the boiling-point rise principle. The sensitive elements are two resistance thermometer bulbs mounted in the vapor and in the liquor either within the body or in the outlet line. The instrument operates to modulate either steam pressure, feed rate, or withdrawal rate.

Another type of control operates on viscosity. Some make use of a rotational viscosimeter. A recent addition to this type makes use of ultrasonic frequencies in a small probe.

#### Acknowledgements

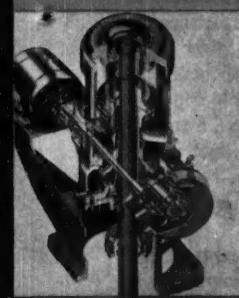
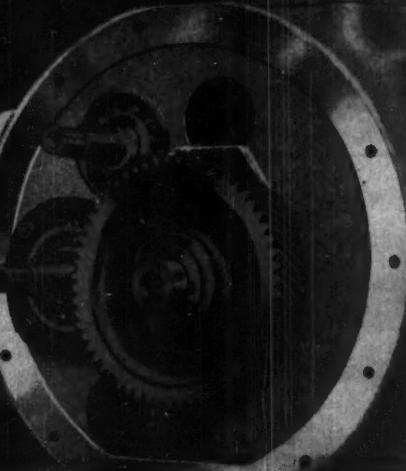
It is not possible to list here all the names of people who sent us information, whom we wish to thank. We do wish, however, to list those who were especially helpful:

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D. A. Rogers	Rodney Hunt Machine Co.
A. R. Gudheim	Rodney Hunt Machine Co.
K. Sauter	Luwa S. A.

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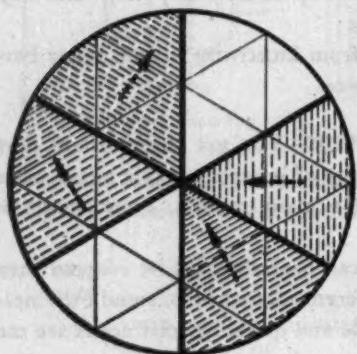
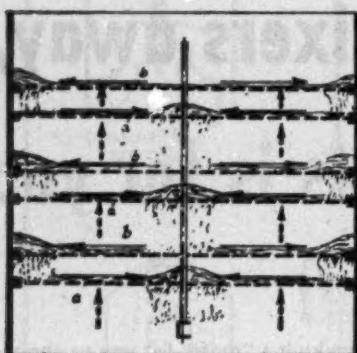
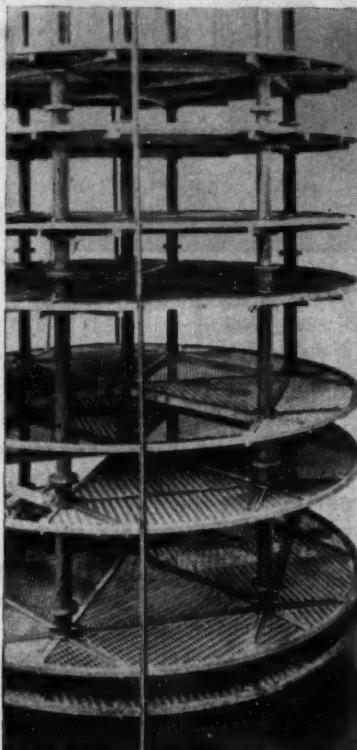


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Kittel plate structures are adaptable to distillation, gas scrubbing, gas purification, and all types of cooling operations. High through-put rates are attained, which means smaller towers and decreased investment.

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achieved by having the ascending vapor stream pass through vertically inclined rhombical plate openings. These openings are produced by expanded metal fabrication technique for low unit cost.

To visualize how these openings are made, imagine a metal sheet pierced by a narrow slit. If one lip of the slit is pushed downward to form a triangular opening and the opposite lip is pushed upward in similar fashion, a vertically inclined rhombical opening results.

Maximum sheet thickness for fabricating the trays is 2 mm. or 0.079 in. The expanded openings produced in

fabrication impart a high degree of rigidity to the plate. Total area of the openings may be as high as 20 percent of the plate area.

Individual circular plate structures are composed of a number of triangular expanded metal elements measuring 20 in. on a side maximum. These elements are held together in a rigid metal-spider framework. Assembly of the small elements is easily accomplished through normal tower manhole openings. Also fewer manholes are required than for bubble cap towers due to the easy insertion, assembly and disassembly of the contact plates. Plate circumference can be sealed against the tower interior by tightening, caulking or welding.

Each plate structure consists of two individual contact plates identified as *a* and *b* in the sketch above. The circular top view shows elements on each of the two individual plates. Those to the left denote the element positions on the topmost or *b* plate, while those on the right show the placing of the elements on the bottom or *a* plate.

On the upper plate, openings are positioned to direct flow in a circular fashion which throws liquid against the tower wall. On the bottom plate, openings are in a position to direct flow toward the center of the column.

There are no downcomers. While liquid tends to concentrate either against the tower wall, or in the center of the plate, it descends to the next plate from these points merely by falling through the perforated openings.

Vertical distance between trays is on the order of 8 in.; between plate structures 16 in. Simplicity of construction permits welding throughout the tower. Resultant tightness of seams is a decided advantage, particularly in vacuum processing where leakage may be detrimental.

Although the Kittel contact plate is just being introduced in this country, it has a ten-year history of industrial usage in Europe. Units are now operating for instance on distillation of fatty acids and alcohols, purification of ammonia gas, entrainment separa-

## Equipment Cost Indexes

(Marshall & Stevens Indexes, 1926 = 100)

Industry	Dec.	Sept.	Dec.
Average of all....	179.6	180.5	180.8

### Process Industries

Cement mfg.	172.3	172.7	173.0
Chemical	180.3	181.1	181.4
Clay products	167.3	167.7	168.0
Glass mfg.	170.4	171.1	171.4
Paint mfg.	173.6	174.4	174.7
Paper mfg.	173.9	174.7	175.0
Petroleum Ind.	176.7	177.8	178.1
Rubber Ind.	179.1	180.2	180.5
Process Ind. avg...	177.7	178.6	178.9

### Related Industries

Elec. power equip...	181.9	183.0	183.3
Mining, milling ....	181.0	182.1	182.4
Refrigerating .....	200.1	200.9	201.2
Steam power .....	169.5	170.7	171.0

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, *Chemical Engineering*, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see *Chemical Engineering*, March 1953, pp. 220, 221.

tion in vacuum systems, debenzolizing of coke oven gas, distillation of glycol, separation of ether and water, cooling of compressed air, as carbon dioxide gas scrubbers, and deodorizing separators.

In cases where bubble cap columns have been converted to Kittel contact plates, tower capacity has been increased from two to three times. On vacuum towers the decrease in pressure loss was from 30 to 50 percent, meaning that a much better vacuum was obtained.

Construction of Kittel contact plates can be made from a variety of metals, including steel, aluminum, copper, or stainless steel.—Charles A. Pfeifferberger, 104-40 194th St., Hollis 12, N. Y.

### Pressure Filter Uses Rigid Membrane

A new precoat, tank-type pressure filter uses synthetic, rigid, porous-stone membranes to support precoat material. Lower operating costs are claimed by elimination of cloth, papers, screens and pads.

Complete cleaning and sterilization can be accomplished without opening the filter chamber. A patented tank closure permits internal inspection or adjustment merely by releasing two bolts. Units are being furnished in a wide range of materials and capacities.—Ogden Filter Co., 4214 Santa Monica Blvd., Los Angeles 29, Calif.

## IN BRIEF—A capsule listing of this month's newsworthy equipment.

	Page
Distillation Trays	242
Pressure Filter	243
Vibrating Screen	243
Vat Fermenters	243

### Processing Equipment

Made of perforated metal for high throughput.....	242
Has rigid porous membranes to support precoat.....	243
Is ruggedly constructed for heavy loads.....	243
Control temperature closely, clean easily.....	243

### Heating & Cooling Equipment

Kettle Furnace	244
Rotary Pressure Joint	244
Flat Heating Elements	244
Level Gage Lamp	244
Air Conditioner	244
Steam Generator	244

### Fluids Handling Equipment

Pump Control System	246
Positive Pump	248
Dust Collector	248
Air Compressor	248

### Electrical & Mechanical Equipment

Lead Cladding Machine	250
Safety Switch	250
Vapor Proof Floodlight	250
Gear Coupling	250
Drafting Symbols	250
Warning Light	250
Gear Coupling	252
High Slip Motor	252
Blueprint File	254
Heavy Duty Switch	254
Jet Cleaner	255
Junction Boxes	255
Jet Cleaner	255
Junction Box	255

### Packaging & Handling Equipment

Roller Conveyor	256
Lift and Fork Trucks	256
Bunker Seal	256
Drum Liner	256
Belt Return Roll	256
Retractable Conveyor	256
Vibratory Feeder	256
Barrel Skid	257
Lift Truck Scoop	257
Hand Truck	257

### Instruments & Controls

Infrared Process Analyzers	258
Control Valve	259
Pressure Meter	260
Chromometer	261
Signal Relay	261
Miniature Speed Changer	261
Gas Analyzer	261
Portable Potentiometer	261

### Vibrating Screen Handles Heavier Loads

A new vibrating screen is designed to handle heavier loads when sizing and processing ore, coal, chemicals, grain, rock, and other bulk materials. Equipped with a heavier yoke, it is mounted on coil springs rather than leaf springs formerly used. A neoprene-rubber, accordion-type boot encloses the spring to keep out sand, stones, and other substances.

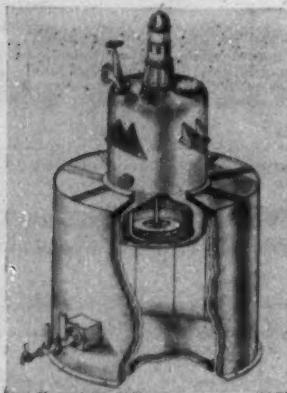
All units of this Model MS screen will have 3-in. discharge lips. Both single and double deck models will be available. The single deck model is designed for easy conversion to two-deck by installation of skirt boards, screen cloth, a buckler frame and discharge lip.—Hewitt-Robins, Inc., 666 Glenbrook Road, Stamford, Conn.

### Close Temperature Control Offered by Vat Fermenters

Certified vat fermenters are now being produced as one-vat units or in combinations of two, three, four or more. Units come in 20 or 40 liter sizes for research laboratories and 30, 50, or 100-gal. sizes for pilot plants. Larger sizes are available for production units.

These fermenters allow control of fermentation temperature to within 0.25 deg. C. Cross-connected lines and valves allow steam under pressure to enter the lines and sterilize the entire system. Units can operate from zero pressure to 50 lb. per square inch of gage. Stirring rates and propeller pitch are easily adjusted. All parts are removable for cleaning, adjusting or changing.—Stainless & Steel Products Co., 1000 Berry Ave., St. Paul, Minn.

## NEW HEATING & COOLING EQUIPMENT



**Kettle Furnace  
Heats by Radiation**

A recently developed furnace is particularly suitable for heating kettles and autoclaves which process heat-sensitive materials. In this new design a rapid flow of radiant heat can be obtained without development of local hot spots.

Kettles or autoclaves to be heated are suspended in the furnace so that radiant heat absorption is very effective for the entire surface within the furnace. Burners mounted near the base of the furnace are designed to produce a vortex of luminous flame. These burners normally operate with little more than theoretically quantities of air.

On initial start-up insufficient combustion air is used in order to build up a thin black deposit over the kettle heating surface. This carbon deposit functions effectively as an absorber for radiant heat.

These furnaces are being effectively used to heat oil-bodying kettles. Since the furnace has low heat capacity, it is possible to control heat input to the kettle merely by reducing or stopping combustion.—Chemical Plants Div., Blaw-Knox Construction Co., 930 Duquesne Way, Pittsburgh 22, Pa.

### **Rotary Pressure Joint Has Long Life**

Long service life with minimum maintenance is claimed for a new rotary pressure joint. Steam up to 550 psi. and liquid up to 3,500 psi. can be conveyed through the joint while it is rotating at high speeds.

Units are provided with either single or double-race ball bearings with self-adjusting wear take-up. The self-lubricating rotary seal and its

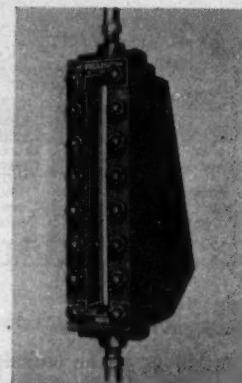
mating part are designed to function under any misalignment up to 10 deg.

Available in all pipe sizes from  $\frac{1}{2}$  to 5 in., inclusive, the joint can be supplied to withstand chemical action from materials being handled.—Anco, Inc., Dept. 1, One Baker St., Providence, R. I.

### **Flat Heating Elements Increase Heat Radiation**

A flat uniform radiation pattern of extremely high intensity is claimed for the Syntron flat-surface electric heating element. By using thin strip elements, the heat output per square ft. has been increased while lowering sheath temperature. Layers of thermal insulation behind the elements are said to produce much greater heat return than reflectors.

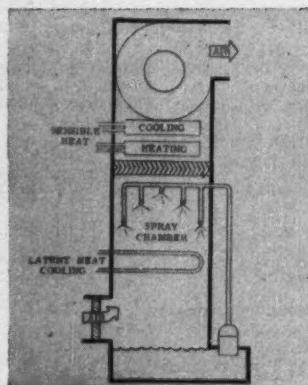
Panels are made up with from two to eight flat surface elements. Panels operate equally well on any commercial frequency, either a.c. or d.c.—Syntron Co., 610 Lexington Ave., Homer City, Pa.



**Mercury Vapor Lamp  
Illuminates Level Gages**

Water level gages on boilers can be read under adverse conditions through installation of a new mercury vapor illuminator. This light shows the water columns as blue green topped with an intensely-brilliant, emerald-green spot at the water level.

The unit consists of a mercury vapor bulb enclosed in a steel housing and a ballast box equipped for easy mounting at a convenient spot. Weatherproof construction makes it suitable for outdoor use. Available sizes fit standard gages.—Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.



**Liquid Contact Unit  
Conditions Air**

A new liquid contact method is said to give closer control when conditioning atmospheric air. Control of relative humidity and temperature are handled independently as separate functions.

Filtered fresh air enters a new type of spray chamber providing especially intimate contact between air and the spray liquid. The spray either adds or removes moisture by absorption or condensation. Spray-liquid characteristics determine the moisture content of air leaving the chamber.

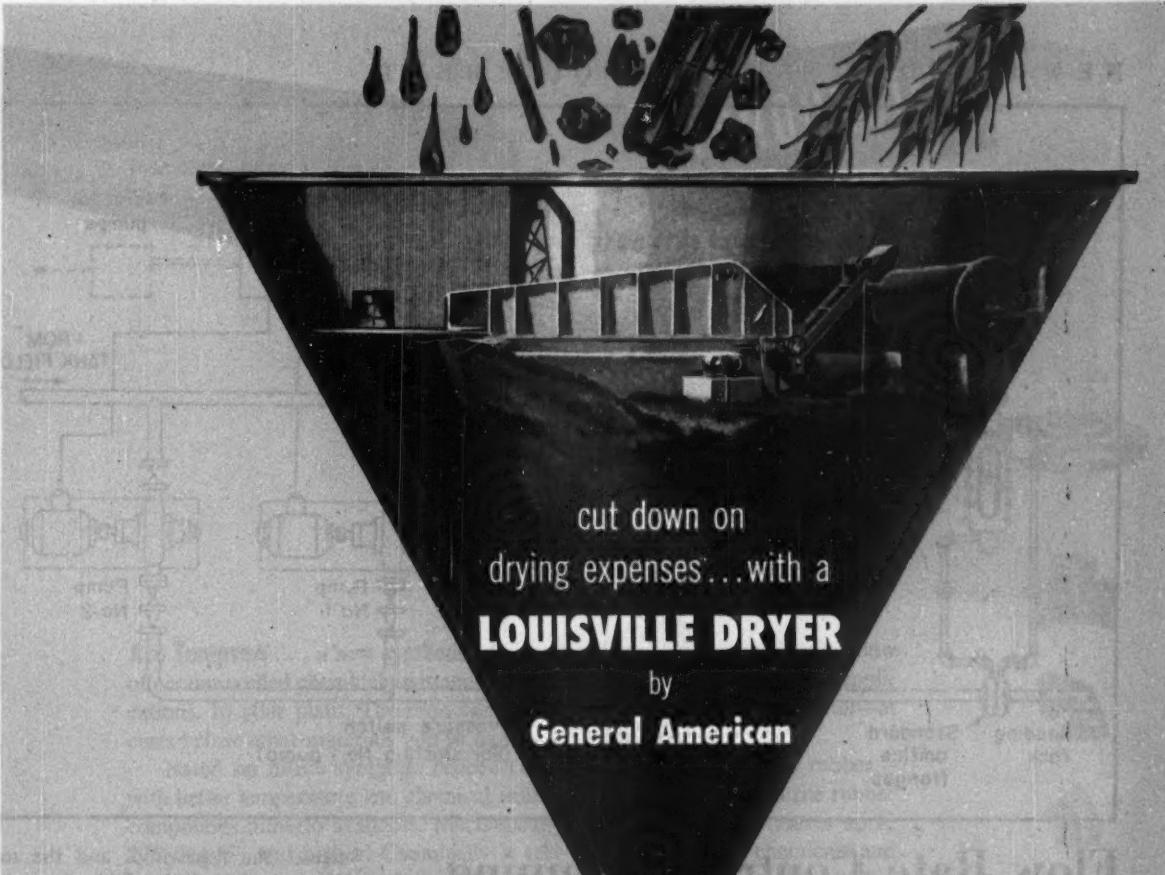
Air temperature is adjusted as a final step. This is said to give trustworthy control of room conditions by means of thermostats without the use of moisture sensitive instruments.—Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.

### **High-Pressure Steam For Heat Exchangers**

High-pressure saturated steam is a better heat source for heat exchangers than superheated steam. A German high-temperature, high-pressure steam generator operates on this principle to give economical supply of heat to chemical industry heat exchangers.

Operating in closed circuit with heat exchanger coils, the Bamag unit is flexible to meet changing heat requirements and has high overload capacity. Temperature of the circulating steam ranges up to 700 deg. F.

Condensate pumps are eliminated by always locating the generator below the heat exchanger. Gas, oil, or coal burners may be used interchangeably.—General Industrial Development Corp., 270 Park Ave., New York 17, N. Y.

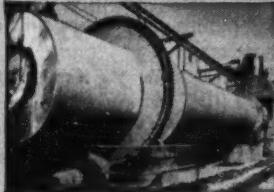


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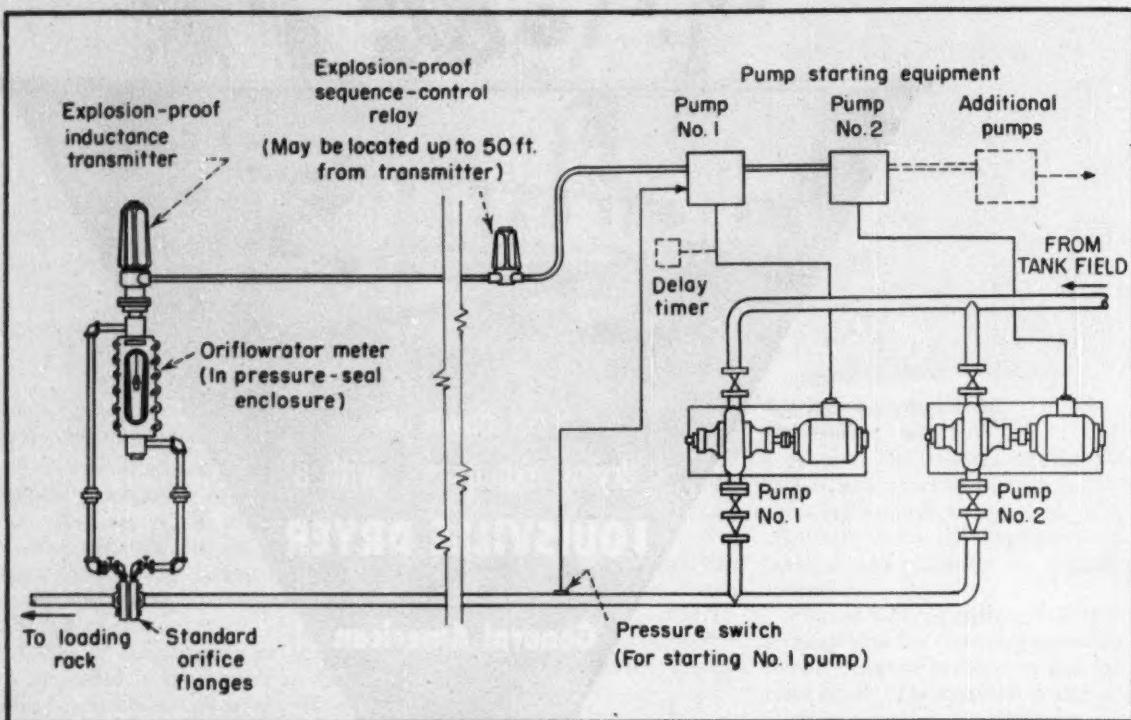
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## NEW FLUIDS HANDLING EQUIPMENT



## Flow Rate Controls Pumping

**Improved sequence control adjusts pumping capacity in multi-pump liquid delivery systems. Initial investment, installation and maintenance costs are lower.**

An improved control system for operating pumps in sequence meets instantaneous demand from discharge lines regardless of fluctuation in demand. A continuous balance is maintained between pumping capacity and flow rate. The system eliminates undesirable and uneconomical features of pressure sensing or manual methods of pump control.

Improved performance rests on use of a precision Oriflowrator flowmeter that measures the flow rate in the discharge line. An inductance transmitter operating in conjunction with the flowmeter places the correct number of pumps in operation.

By referring to the schematic sketch you can see how this system operates. As soon as a discharge nozzle is opened a pressure switch located in the discharge line senses the pressure drop and turns on pump No. 1. This is the only pressure switch used.

As liquid moves through the line the Oriflowrator meter located on a by-pass of the main discharge line measures the flow. Since a known proportion of total flow is by-passed through the meter, calibration is set to read main line flow directly.

As the meter float rises in response to the rate of line discharge a nickel alloy tube mounted on the float moves up into an inductance transmitter directly above the meter. The transmitter contains a number of flat coils spaced vertically. As the nickel tube moves up through the center of each coil it changes the coil impedance sharply. This impedance change is picked up by a simple Thyatron circuit which trips the starting switch for each successive pump motor. Thus, the float position both indicates the rate of flow through the line and starts the number of pumps required.

Conversely, as the demand de-

creases the float drops and the rod descends out of the field of successively lower coils, shutting off the unneeded pumps. All pumps shut off when flow ceases.

Coil positions in the transmitter are set at the factory, based on a knowledge of the nozzle capacity and pumping capacity of each individual installation. However, coils can be reset in the field.

A wide range of flows from very low rates to maximum capacity can be handled due to the sensitive response of the Oriflowrator. This meter is a kinetic manometer as contrasted with the static manometer usually employed with conventional pressure differential meters. With a kinetic meter of this type, only a portion of the total flow need be measured. Flow rate can be indicated on a linear scale rather than the square root graduated scales used on most static manometers. A linear scale permits accurate reading of the meter even at low flows, and a large range of flows can be handled with a scale of convenient size.

A time delay switch connected in series with the first pump keeps that pump operating for an additional time interval to satisfy erratic flow rates associated with topping off.

ANNOUNCING

# ace tempron

*New* HIGH HEAT RESISTANT  
HARD RUBBER

pipe · fittings · chemical parts

Ace Tempron . . . a new synthetic hard rubber for chemical equipment—now offers unexcelled chemical resistance *plus* economy for high temperature applications. In your plant, Tempron can handle many corrosive liquids—*hot*—at costs below other materials you've had to use up to now.

Based on nitrile synthetic rubber (Buna-N), Tempron is *hard* rubber—with better temperature and chemical resistance than hard or soft nitrile rubber compounds hitherto available. Mechanically it withstands temperatures up to 225 deg. F. and higher. Chemically it resists most inorganic chemicals and many organic chemicals and oils at temperatures to 200 deg. F.—and far higher in specific instances. At room temperature it has better resistance to some of the organic chemicals than other rubber and plastic materials.

In one case, Tempron pipe is still in excellent condition after 2 years on hot brine, far exceeding the life of the steel pipe it replaced.

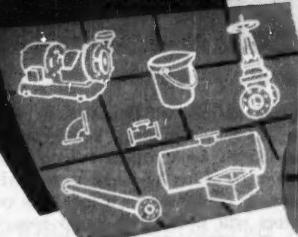
We're now ready with Tempron pipe in 1", 1½", 2", 3" and 4" sizes and fittings in 2", 3" and 4" sizes. Additional smaller sizes of pipe and fittings are under development. We can also—now—produce molded parts, and sheets, rods and tubes from which we (or you) can fabricate a wide variety of parts.

Write today for new bulletin No. 96-A giving full details of Tempron. Or ask for samples and recommendations for your specific applications.

#### ACE TEMPRON resists:

TESTED AT 200 deg. F.	Hydrochloric Acid, 38% Sulphuric Acid, 50% Phosphoric Acid, 85%	Sodium Hydroxide, 20% Sodium Chloride Ethylene Glycol	Formaldehyde Kerosene Ferric Chloride Stannous Chloride
TESTED AT 78 deg. F.	Benzaldehyde Aniline Pyridine Gasoline	Ethyl Acetate Benzene Toluene Carbon Tetrachloride	Ethylene Dichloride Chlorobenzene Carbon Disulfide Nitrobenzene

more RESISTANT  
TO more CHEMICALS



ACE rubber and plastic products

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## NEW FLUIDS HANDLING EQUIPMENT

It is desirable, though not necessary, to include a pressure accumulator to smooth out sudden pressure changes.

For hazardous locations, the inductance transmitter and control relay are furnished in explosion-proof housings. In addition, the flowmeter can be housed in a pressure-sealed enclosure. This prevents liquid spillage in the unlikely event of breakage of the Pyrek metering tube.—*Fischer & Porter Co., Hatboro, Pa.*



### Telescoping Cylinders Give Positive Pumping

Positive displacement pumping is provided by the Dudley V-9 pump through use of a telescoping cylinder effect. Two cylinder blocks, each containing nine cylinders, are angularly mounted inside a common housing. Nine metal sleeves connect the cylinders of one block with their counterparts in the opposing block. These sleeves slide freely in the cylinders.

One cylinder block is connected to a drive shaft. All cylinders in this block are blind holes. Cylinders in the opposing block go straight through opening onto the inlet and discharge chambers.

As the cylinder block assembly rotates, starting at the point of closest contact between cylinder blocks, the total cylinder volume increases to a maximum 180 deg. from the starting point. With the increase in cylinder volume, liquid moves into the cylinders from the inlet chamber.

Rotation continuing from 180 deg. to 360 deg. gradually decreases total cylinder volume, thereby expelling liquid into the discharge chamber.

Simple in design, the pump has no connecting rods, cams or springs. Delivery volume ranges from 2.4 to 7.2 gpm. at pressures from 9 psi. to 433 psi. Operating temperature range is -60 deg. F. to +165 deg. F. Construction is either aluminum or bronze.—*Eastman Pacific Co., 2320 East 8th St., Los Angeles 21, Calif.*

### Dust Collector Uses Cloth Efficiently

Constructed of aluminum and featuring a simple automatic cleaning mechanism, the Simon suction-filter dust collector is said to offer high efficiency. Advantages claimed are high air to cloth ratios, low maintenance, low power requirements, and maximum accessibility.

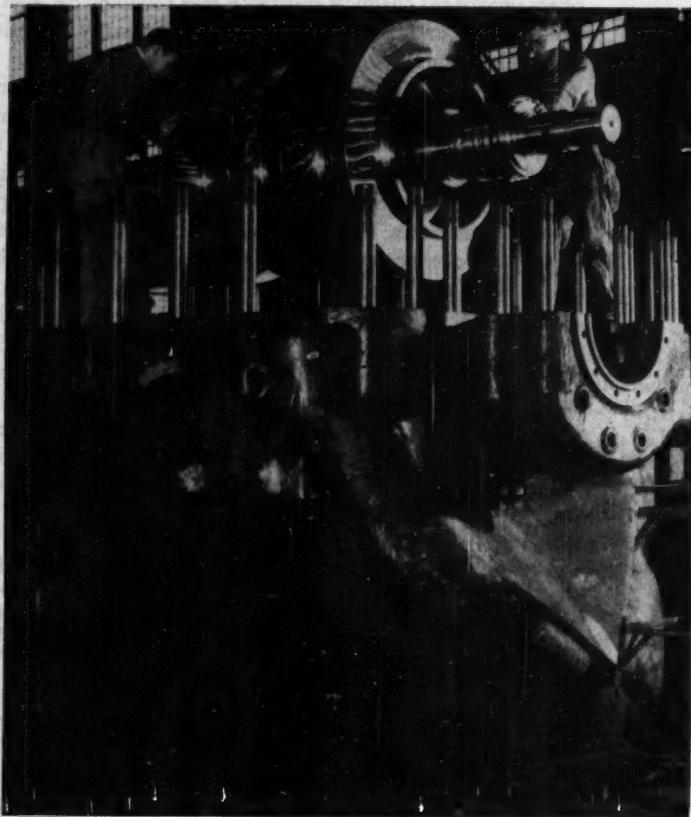
Each collector is made up of from two to twelve sections. The individual sections contain eight cloth filter sleeves with a separate inlet manifold, dust discharge hopper and cleaning mechanism for each section.

Dust-laden air is drawn into the inlet manifold and hopper where a drop in velocity permits coarse particles to be dropped out. Fine dust is carried

up inside the cloth sleeves, where it is retained, permitting clean air to pass through to discharge.

In each section the top supporting bracket and bottom tray of the filter tube assembly are rigidly connected by tie rods. During the cleaning cycle a mechanical device lifts the entire assembly approximately 1½ in., then drops it. Shock produced dislodges the dust layer from the cloth, aided by a reverse air flow.

This method of cleaning produces minimum stress or tension on the filter sleeves, resulting in long cloth life. A twenty second interval out of every five minutes is devoted to cleaning.—*Entoleter Div., The Safety Car Heating & Lighting Co., Inc., 1687 Dixwell Ave., New Haven, Conn.*

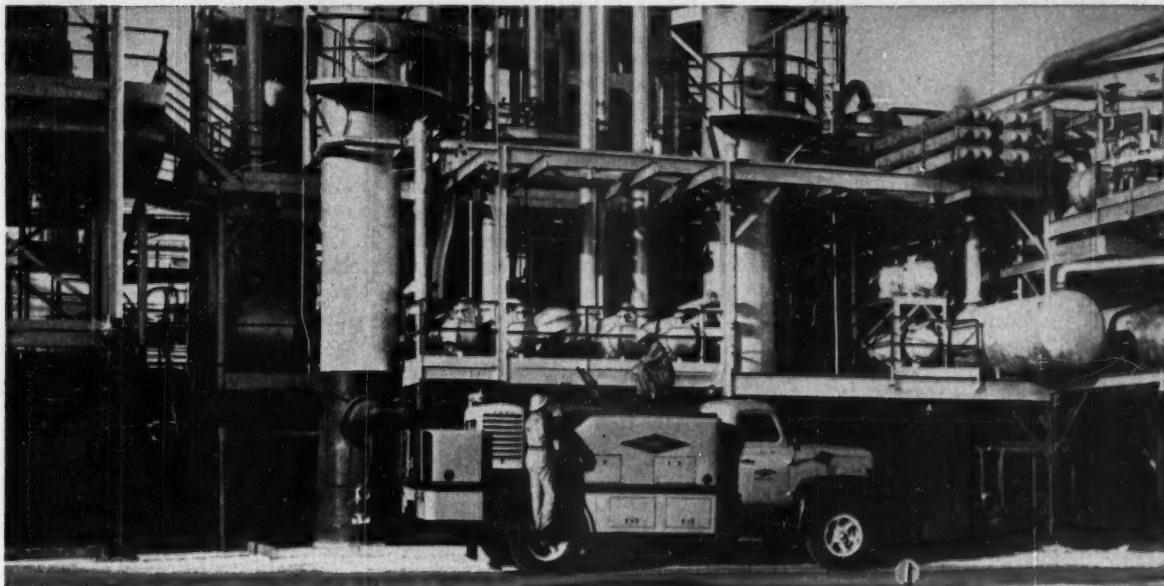


**GIANT AIR COMPRESSOR BUILT FOR CAT CRACKER**

Here you see a four-stage rotor being lowered into position in the lower case of a multi-stage centrifugal compressor. This is one of several multi-stage centrifugal compressors said to be the largest ever built for discharge pressures of 100 psi. Rated for 100,000 cfm. and driven by steam turbines of approximately 8,000 bhp, these units will be used as main air compressors on four new catalytic cracking units. The 4½-ft. diameter rotors will operate at 3,600 rpm. Total compressor weight is 70 tons.—*Clark Bros. Co., Olean, N. Y.*

# TOWER CAPACITY RESTORED IN ONE DAY BY CHEMICAL CLEANING

Through-put increased from 500 to 800 gallons per minute by Dowell Service



The capacity of a fractionating bubble-cap tower, operated by a southern chemical company, had dropped from 800 to 500 gallons per minute. Heavy deposits covered the traps and clogged the bubble-caps. Dowell engineers analyzed these deposits and found them to be iron sulphides, oxides and organic material. Dowell Service removed these deposits from the tower in only one day with specially prepared liquid solvents. Result: the tower was restored to its original 800 g.p.m. capacity.

In the Dowell method of chemical cleaning, solvents are applied according to the technique demanded by the job: filling, spraying, jetting, cascading or vapor-

izing. Being liquid, they will go wherever steam or water will flow, reaching surfaces inaccessible to other cleaning methods. No special scaffolding is required. Dismantling and downtime are kept to a minimum. Experienced Dowell engineers do the job for you using Dowell-designed pump trucks and control equipment which are brought right into your plant. Towers are just one of hundreds of pieces of industrial equipment which can be cleaned chemically by Dowell Service. For complete information and estimates on the cleaning of your equipment, call the nearest Dowell office, or write directly to Tulsa, Dept. D33.

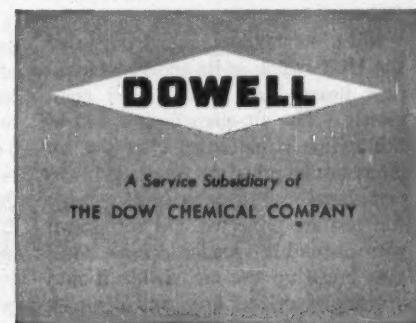
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## NEW ELECTRICAL & MECHANICAL EQUIPMENT



**Lead Cladding Machine Outmodes Hand Techniques**

Time required to clad lead to steel has been cut 90% by a new versatile automatic machine. A perfect chemical bond is obtained between the lead and steel; no separation of lead from steel will occur in service unless the lead melting temperature is exceeded.

Weighing less than 15 lb., the cladding machine can be mounted directly on a carriage running on the surface being treated or suspended from a carriage running on an overhead beam. In operation, a strip of lead is laid down under the machine; the cladding heads melt this lead and chemically bond it to the steel as the machine automatically moves across the plate. Machine adjustments permit handling lead strips up to 12 in. wide by  $\frac{1}{4}$  in. thick.—Knapp Mills, Inc., 23-15 Borden Ave., Long Island City, N. Y.

### Safety Switch Fills Heavy-Duty Need

Latest edition to the Trumbull HCI (high capacity interrupter) switches is one rated at 200 amp., 600 v., fusible and no fuse front-operated design. Immediate availability of this switch rounds out the manufacturer's line of 30-, 60- and 100-amp. switches.

Most outstanding characteristic of the HCI switch is its ability to interrupt heavy loads quickly and completely. The arc-quenching action of this switch is patterned after the arc interrupting principle of modern circuit breakers. Double-break visible contacts are projected and withdrawn with piston-like speed and force. Grid pins break up the arc, divide it into a series of smaller arcs, and dissipate

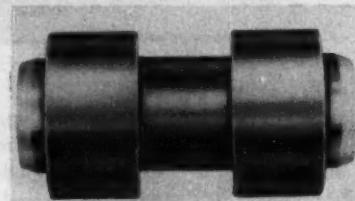
the heat. Thus contacts do not pit.

Another important feature offered in all four ratings is a felt gasket which blocks dust and dirt from entry into the enclosure. Unlike other switches, the HCI is said to be virtually free from direct openings to the interior.—Trumbull Electric Dept., General Electric Co., Plainville, Conn.

### Vapor-Proof Floodlight Has Adjustable Beam

The Type 1570 pit and subway light is especially designed for recessed or surface mounting in walls or ceilings. The rectangular housing is vapor-proof to withstand heavy moisture. Adjustment of the light beam either 18 deg. upward or downward from center can be attained with the pivoting reflector.

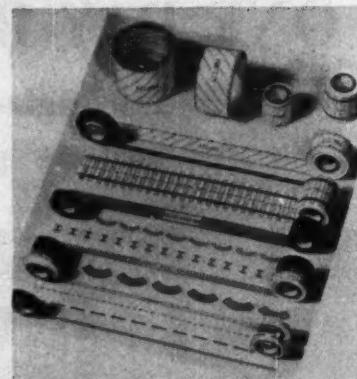
Enclosure glass is heat and impact resistant. Hinged, heavy wire guards are optional. Drainage slots are provided on the cover to prevent accumulation of standing water.—The Pyle-National Co., 1334 North Kostner Ave., Chicago 51, Ill.



**Gear Coupling Disconnects Quickly**

A new Spacer-type gear coupling can be disconnected in a matter of seconds without wrenches or special tools. Similar in function and general design to conventional flange-and-bolt Spacer types, the unit makes possible the removal of hubs from either shaft without disturbing the mountings of the connected unit.

There are flexible hubs on both the driver and driven shaft. The center unit or spacer has specially designed teeth at either end cut so that they mate with each sleeve in a fine fit. These connections have no angular or offset flexibility, but allow for end float. The two sleeves connect to the driver and driven unit through the spacer.—Sier-Bath Gear & Pump Co., Inc., 9252 Hudson Blvd., North Bergen, N. J.



**Printed Symbols on Tape Save Drafting Time**

Lay aside your pencils when it comes to drawing repetitive symbols. Now you can merely select the required symbol and peel it off a roll of preprinted pressure sensitive adhesive tape. All that remains is to place the correct length of tape bearing the symbol at its designated position on the drawing.

An added advantage is that changes in temporary layouts can be made instantly simply by stripping the tape from its original position and placing it wherever wanted. The pressure sensitive quality of the tape permits it to be stripped off repeatedly without leaving a mark or losing its adhesive quality.

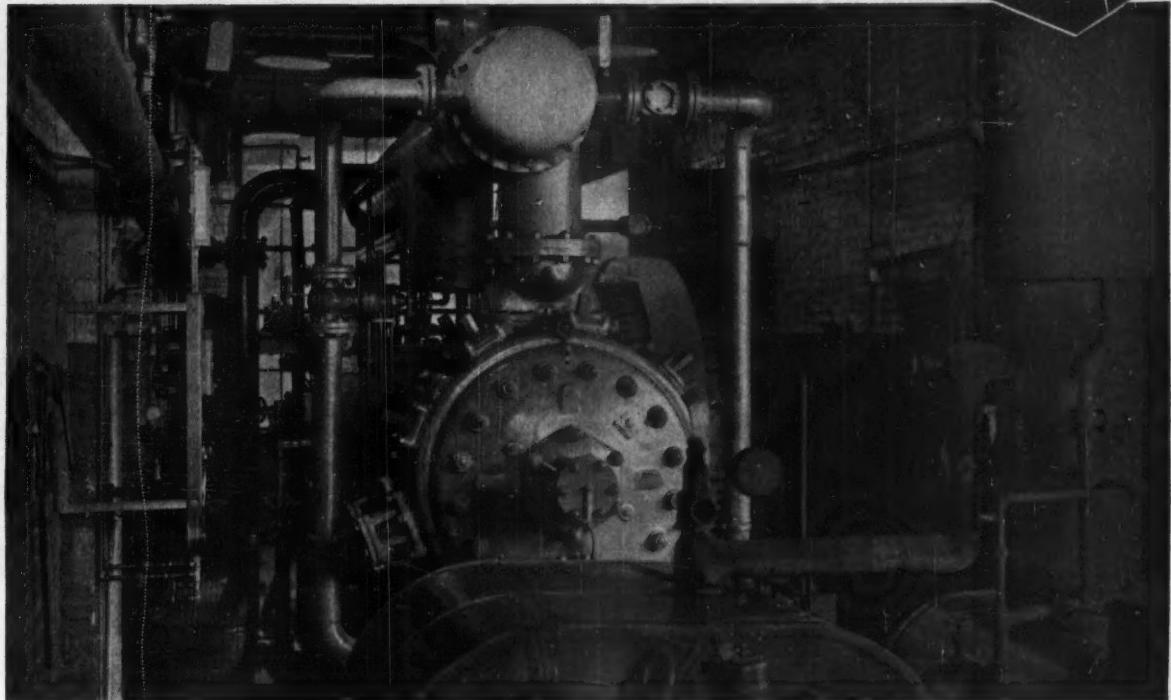
All standard symbols for walls, aisles, conveyors, monorails, center line columns, shafts, airways, service lines, railroad tracks, sidings, colored arrows for material and process flow are available in either 324-in. or 648-in. rolls. At present, all symbols are furnished for a  $\frac{1}{4}$ -in. to 1-ft. scale in opaque or transparent types. Additional symbols will soon be available as well as a complete selection to scale  $\frac{1}{8}$  in. per ft.—Labelon Tape Co., Inc., 450 Atlantic Ave., Rochester 9, N. Y.

### Warning Light Throws Moving Beam

Three new models have been added to the Gyralite group of industrial warning lights. These lights project a high intensity colored or clear beam which rotates with a wide sweeping action. This movement commands immediate attention to points of danger.

Type 1740 Gyralite has a single, sealed-beam lamp mounted in a gyrating mechanism within a cast alumin-

# Is available floor space holding back expansion of your plant air facilities?



Haven't got the floor space for additional plant air facilities? Don't be too sure!

How about the nooks and crannies, or right in among your machine tools? Other plants are squeezing Clark Balanced/Opposed Compressors in many such "impossible" places. The above illustration, in an aluminum forging plant, is a typical example. Here a 600 hp, 3200 cfm Clark unit was squeezed into a 20 x 13 ft. floor area.

It's a fact that a Clark Balanced/Opposed Compressor can be moved in anywhere. One of the reasons is its compactness. Another is its absolutely vibration-free performance. You can set it in a corner, on a second floor, or alongside even the most delicate of machining operations. The savings in building, piping and installation costs are considerable.

For full information on this modern, motor-driven compressor (150-4500 hp range), request Bulletin 118, or call your nearest Clark representative.

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prefer

## AIRETOOL TUBE EXPANSION CONTROL SYSTEM

# rolls tube joints tight automatically



Now science replaces "sensitive feel" in tube rolling! The AIRETOOL Tube Expansion Control System eliminates danger of over or under expansion. It automatically regulates the amount of expansion, produces maximum tightness and holding strength in every tube joint! With this system you can actually cut tube rolling time in half! Easy to use. Set dial for tube size, insert ball bearing expander and start powerful motor. When the tube joint reaches proper expansion and tightness, the control automatically shuts off the power. For more information and a convincing demonstration, write to:

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MANUFACTURING COMPANY  
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## EQUIPMENT NEWS, cont. . .

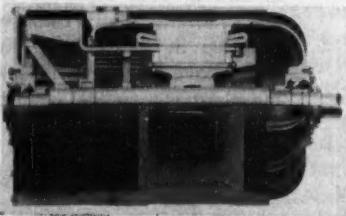
num alloy housing. Type 17340 has two sealed beam lamps. One lamp is mounted in the gyrating mechanism, while the other is mounted stationary in the body for use as a headlight or back-up light on moving equipment. Type 15100 has stationary lamp and rotating reflector for low-voltage duty.

In processing industries these lights are used as overflow or low level alarms, or to warn of contaminated atmosphere. In many of these applications automatic remote control is necessary or highly desirable for maximum safety. Time switches, pressure switches, float switches, electric eye, or any other available automatic contactor can be used in conjunction with Gyralites.

Other industrial applications are on hazardous moving equipment and on hazardous doorways, cross walks, open pits and manholes.—The Pyle-National Co., 1334 North Kostner Ave., Chicago 51, Ill.

### Gear Coupling Is Made of Nylon

Small gear-type couplings fabricated of nylon are now available for shafts from  $\frac{1}{8}$  to  $\frac{1}{2}$  in. Two externally geared hubs mounted on the shafts to be coupled are slid into either end of the ring-gear locking sleeve. Hubs are keyed to the shaft and locked in position by set screws. The tough unbreakable nylon construction withstands corrosion and is not affected by most liquids and gases.—John Waldron Corp., New Brunswick, N. J.

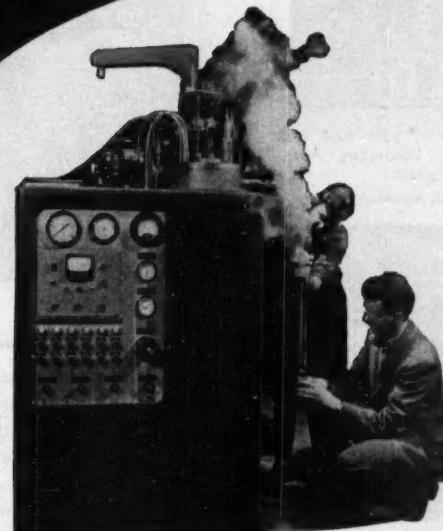


### High Slip Motor Is Smaller and Lighter

Use of a new extended rotor bar design for more efficient heat dissipation has caused substantial weight reduction in the new Type KRX high slip induction motor. This totally enclosed fan-cooled motor is used for driving punch presses, centrifuges, hoists, etc., where high inertia loads must be accelerated.

The high resistance metal required

# UNIQUE PROTOTYPE DEVELOPMENT



Liquefying helium gas to produce temperatures near Absolute Zero (minus 460°F) was one of engineering's most difficult thermodynamic problems. The ADL Mechanical Division produced the Collins Helium Cryostat to answer this problem, thereby creating a significant tool in the advancement of science.



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## THE AMERICAN PLATINUM WORKS

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for high slip characteristics is formed in the shape of a radial-blade fan and brazed to the low-resistance extended rotor bars. Thus, most of the rotor heat develops where there is a direct transfer to the cooling air. A baffle plate isolates the fan blades from the motor enclosure, thereby reducing heat within this area.

Boasting of size reduction up to 30 percent and weight reduction of as much as 40 percent over conventional motors in this class, the Type KRX motor is available in 30 to 150 hp. at 900 and 1,200 rpm., 5-8 and 8-13 percent slip. Voltage ratings are 220, 440 and 550.—General Electric Co., Schenectady 5, N. Y.



### Blueprint File Reduces Search Time

Valuable engineering man-hours are claimed to be saved through use of the Draw-In-Dex filing cabinet. Drawings, tracings and blueprints are neatly and conveniently stored; a card index permits locating prints immediately.

Drawings are suspended by manila hangers on suspension rods. Where desired, aluminum hangers permit filing a large number of drawings together. All prints are immediately accessible. Any print can be removed without disturbing other prints.

Cabinet is constructed with an 18-gage steel top and 16-gage reinforced steel side. Index cards, manila hanger strips and lock are standard equipment.—Empire Development Corp., 15 Park Row, New York 38, N. Y.

### Heavy-Duty Switch Withstands Severe Usage

Combining the functions of disconnect and load interrupter, the new metal enclosed Disruptor switch is

designed for heavy-duty 600-v. a.c. or d.c. service. Rugged construction makes this switch capable of withstanding severe usage. Internal design and quick-make, quick-break mechanism offers safe, positive load interruption. The device has been thoroughly tested under load conditions and has proved able to interrupt its rated capacity with ample safety factor.

The switches are available in ratings of 400, 600, 1,200, 2,000 and 3,000 amp.—Delta Star Electric Div., H. K. Porter Co., Inc., 2437 Fulton St., Chicago 12, Ill.

#### Hydraulic Jet Lifts Grease and Grime

Heavily encrusted dirt, grease and grime on industrial equipment is said to be easily removed by the Speedyelectric Hydrafjet. A powerful pulsating hydraulic jet delivered at pressures up to 600 psi. and at 4 to 8 gpm. tears off heavy dirt accumulations. Water is at scalding temperature mixed in any desired concentration with suitable detergents.

The Hydrafjet is easily installed, requiring only connections to existing steam lines and electric power sufficient for a 3-hp. motor. If central plant steam is not available, a Speedyelectric boiler can be furnished.—Livingstone Engineering Co., 100 Grove St., Worcester 5, Mass.

Vapor-tight junction boxes constructed of Alumalloy are 4 in. in diameter and from  $1\frac{1}{2}$  to  $3\frac{1}{2}$  in. deep. Conduits up to 1 in. can be accommodated.—Killark Electric Mfg. Co., Vandeventer & Eastern Aves., St. Louis 13, Mo.

Jet cleaning unit brings the advantages of hydraulic jet cleaning to plants with low-pressure steam facilities. Using ordinary cold water and plant steam from 5 to 25 psi. the booster jet is said to discharge a solid stream of hot water at 160 to 210 deg. F. with a pressure of 100 to 200 psi.—Sellers Injector Corp., 1600T Hamilton St., Philadelphia 30, Pa.

Explosion-proof junction box constructed of rust-proof, corrosion-proof, Alumalloy is strong and light weight. Measuring 10x8x5 $\frac{1}{2}$  in. the GRJ box will take conduit up to and including 3-in. sizes.—Killark Electric Mfg. Co., Vandeventer & Eastern Aves., St. Louis 13, Mo.

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## NEW PACKAGING & HANDLING EQUIPMENT

### **Roller Conveyor Meets Heavy-Duty Needs**

A new line of heavy-duty roller conveyors is built to handle loads up to 600 lb. per roller. Sections are available in widths from 6 to 36 in., and 5- or 10-ft. lengths. Ninety-degree curves can also be furnished.

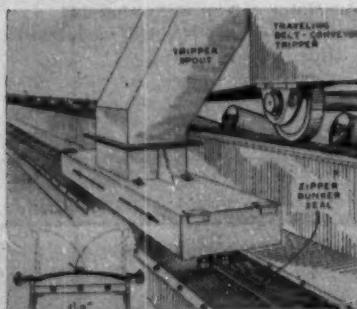
Rollers are 24-in. diameter with  $\frac{1}{2}$ -in. wall thickness. Bearings may be either standard heavy-duty, grease packed or dust sealed.—Sage Equipment Co., 31 Essex St., Buffalo 13, N. Y.

### **Lift and Fork Trucks Pay As You Go Basis**

Two manufacturers of industrial lift and fork trucks have recently announced plans whereby prospective users may lease equipment rather than buy it. These plans have been worked out in cooperation with the C. I. T. Corp., the industrial financing subsidiary of C. I. T. Financing Corp.

Leasing arrangements will be worked out between manufacturers' sales representatives and the prospective user. C. I. T. then will purchase the equipment from the manufacturer and lease it to the user. Payments will be made on a monthly basis.

An alternate plan provides for installment purchase based on an initial down payment followed by regular monthly payments for a definite period of time.—The Yale & Towne Mfg. Co., Roosevelt Blvd. & Hallderman Ave., Philadelphia 15, Pa.—Automatic Transportation Co., 149 West 87th St., Chicago 20, Ill.



### **Zipper Bunker Seal Stops Dusting**

Use of a zipper toothed bunker seal, together with a traveling tripper discharge, makes for dustless transfer of solids from belt conveyor to storage



### **RETRACTABLE CONVEYOR SPANS RAILROAD SIDING**

Two buildings separated by a railroad siding have been linked by a retractable boom conveyor for transfer of heavy packages. To permit passage of railroad freight cars, the conveyor is simply pulled back onto the platform of one of the buildings. The enclosure mounted over the conveyor protects packages passing between the two buildings. The live roller boom is equipped with a fully enclosed drive mechanism.—Alvey Conveyor Mfg. Co., 9301 Olive St., St. Louis 24, Mo.

bunker. Designed primarily for power plant coal systems, the seal is equally effective in mining, chemical, and other industries where traveling trippers are used.

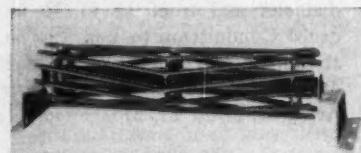
Flat belts are fastened to opposite edges of the bunker opening. Zipper teeth along the edge of each belt mesh tightly down the center line to form a dustproof connection. The reversible, belt-operating mechanism hangs from the tripper spout. Rollers at each end of the mechanism spread the zipper teeth for easy opening or closing. Rollers are mounted on pantograph frames to maintain proper belt contact at all times.

Since the belt is open only directly under the discharge point, dust cannot escape. The metal shield on the tripper chute completes the seal. Grate bars under the seal belt protect the operator from accidental injury due to stepping on or through the belt.—Stephens-Adamson Mfg. Co., 274 Ridgeway Ave., Aurora, Ill.

### **Drum Liner Has Circular Disk Bottom**

A new polyethylene drum liner has a circular disk bottom for easier use and elimination of leaks and ruptures.

A fiber disk between two layers of polyethylene forms the circular bottom. Liners range in gage from 0.0015 to 0.006. Sizes are available for use with drums ranging up to 55-gal. capacity.—Mehl Mfg. Co., 2055 Reading Road, Cincinnati, Ohio.



### **Belt Return Roll Is Self-Cleaning**

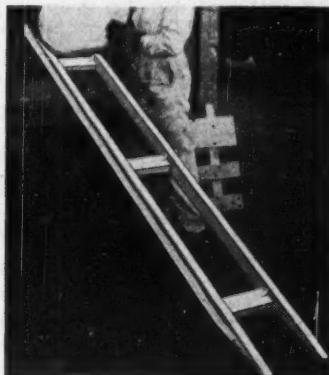
Build-up of wet, exceedingly fine or sticky materials on belt conveyor return rolls is said to be eliminated by the chevron rod return roll. Round metal rods welded to supporting flanges form the roll surface. Open space between rods provides self-cleaning. Vibration or slapping action between roll and belt dislodges any material before it can build up on the roll.

The chevron rod design exerts an aligning force on the belt. True alignment is thus easier to maintain and edge wear is eliminated.—Barber-Greene Co., 400 North Highland Ave., Aurora, Ill.

### Vibratory Feeder For Low Rates

Model F-00 vibratory feeder handles up to 500 lb. per hr. of bulk material. This new model utilizes the same electromagnetic vibrating principles as its larger counterparts. Rate of material flow is controlled by a rheostat, giving a range from a mere trickle to a gushing flow.

Measuring 7½ in. high x approximately 14 in. long, the feeder weighs 14 lb.—Syntron Co., 610 Lexington Ave., Homer City, Pa.



### Magnesium Barrel Skid Is Light and Strong

A new all-magnesium barrel skid facilitates the movement of barrels between two levels, such as truck tail board to ground. Welded construction throughout assures certified capacity-rated strength combined with light weight and comparative ease of handling.

Use of the skid is said to reduce risk of lifting injuries and provide greater safety for men and equipment. Skids are available in standard sizes ranging from 5 to 18 ft. in length.—Magline, Inc., Mercer St., Pinconning, Mich.

Lift truck scoop facilitates bulk handling operations. Loading is accomplished by rotating the scoop. Scoop can also be raised or lowered in fashion normal to lift truck operation.—The Elwell-Parker Electric Co., Dept. E, 4205 St. Clair Ave., Cleveland 3, Ohio.

Hand truck for moving barrels and cases is constructed with a heavy steel shovel-type nose plate. Truck is sturdy all-welded construction equipped with two 6-in. diameter wheels.—Palmer-Shile Co., 16037 Fullerton St., Detroit 27, Mich.

## Chemiseal Packing Seals This LAPP PORCELAIN VALVE



## Ideal Combination for "All-Chemical" Service

Now, manufacturers and users of all types of special chemical-resistant valves, pumps, processing equipment and piping are no longer limited by the shortcomings of vital sealing materials.

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And United States Gasket Company engineering and fabricating experience has made the most of Teflon's outstanding mechanical properties—its resiliency, anti-hesion and anti-friction qualities—to adapt it to the operating requirements of all types of chemical equipment.

The "Tufclad"® chemical porcelain valve above for instance, made by the Lapp Insulator Co., Inc. of Le Roy, N.Y., utilizes a wedge-type Chemiseal Packing which effects a seal with extremely low gland pressure and friction load on spindle. This type packing is particularly suitable for ceramic valves, as well as glass-lined, Haveg, Karbate and valves made of similar materials.

Write for catalog. For valve packing, request 810 series. For pump packing, request 711 series. For emergency bulk and extruded stuffing-box packing, request 620 series.

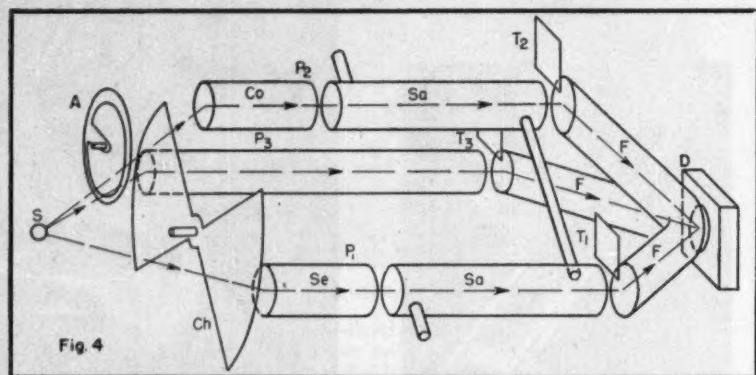
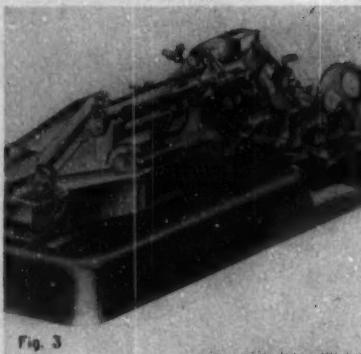
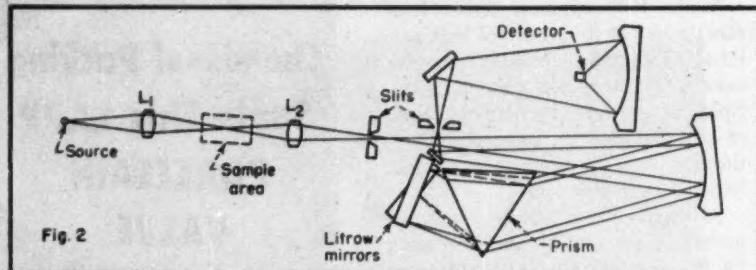
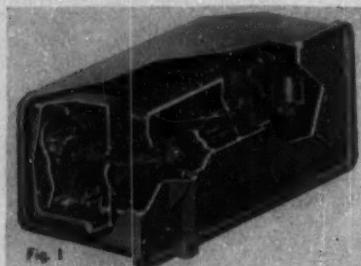
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## NEW INSTRUMENTS & CONTROLS



## Process Analyzers Use Infrared

**Instrument manufacturer introduces two new process stream analyzers of infrared type, one operating on the dispersive principle, the other of positive filter type.**

Adding to the growing list of commercially available infrared process stream analyzers, Perkin-Elmer Corp. introduced two such instruments last month. One instrument, the new model 105 Tri-Non analyzer, is of the non-dispersive type and is somewhat similar in principle to other process stream analyzers now on the market. The other instrument, known as the model 93 Bichromator analyzer, is unique in being a plant scale adaptation of the dispersive type instrument used for precise laboratory work.

To make the distinction clearer, the Bichromator analyzer dispersive instrument is a spectrometer and uses a prism to disperse the radiation transmitted by the sample. The instrument then selects two particularly significant wavelengths of the transmitted radiation and measures the ratio of their intensities, interpreting the analysis of the sample in terms of this ratio.

The Tri-Non non-dispersive instrument, however, is not a spectrometer

but a filter type, measuring and comparing all the radiation which is transmitted through a number of trains of cells containing various combinations of the sample, the component analyzed for, and any interfering components that may be present.

Referring to Figs. 1 and 2, which show the Bichromator analyzer, the instrument consists of an infrared source, lenses  $L_1$  and  $L_2$ , between which is placed a continuous-flow sample cell of suitable length, and an optical system comprising slits, mirrors, a prism, a split Litrow mirror, and a detector for the emergent radiation.

Various compounds yield unique characteristic curves of percent transmission (or absorption) of the radiation vs. its wavelength. All the radiation unabsorbed by the sample is dispersed by the prism. In a laboratory instrument this dispersed radiation would be scanned over the entire range of wavelengths and the result plotted automatically as percent transmission vs. wavelength. In the Bi-

chromator analyzer, however, instead of scanning the entire range, the instrument automatically selects two of the wavelengths by means of the split Litrow mirror, and measures the ratio of their intensities continuously by means of an optical null principle.

Usefulness of the instrument in any particular analysis of a gas or liquid mixture depends on the proper selection of the two wavelengths which are ratioed. One is characteristic of the component analyzed for, while the other is selected for its ability to compensate for other components in the mixture. An important advantage of this type instrument is the ability to predict its performance accurately from the known absorption curves for the components and mixture. An additional advantage of the dispersive type instrument is its ability to analyze liquid as well as gas streams.

The Tri-Non analyzer, shown in Figs. 3 and 4, is a non-dispersive instrument of the so-called positive-filter type. It is unique among instruments of this sort in employing three rather than the usual two radiation paths, together with a novel method of null balancing. In Fig. 4  $Sa$  represents the continuous-flow sample cell which is present in both the  $P_1$  and  $P_2$  paths. The sensitizing cell  $Se$  is contained in path  $P_1$  and the compensating cell  $Co$  in path  $P_2$ . Path

$P_1$  is used for the null balancing and contains the attenuator A which is automatically adjusted to a null balance. Radiation from source S, having passed through the three paths, enters the detector D by way of the filter cells F. A chopper Ch interrupts the radiation so that the detector successively sees radiation from the three paths.

Assuming a sample containing components A, B, C, D, etc., which is to be analyzed for B, cell Se and detector D are filled with pure B. The trimmers T are then adjusted so that D receives radiation such that  $P_1 + P_2 = P_3$ . Then when the sample flows through Sa, it reduces the energy flow through  $P_3$  more than  $P_1$  since the characteristic absorption of component B has already been exerted in  $P_1$  by the presence of B in cell Se. The alternation of heating effect received by D as Ch rotates produces an a.c. signal which is then used to move A until a null signal again results. Motion of A is recorded by a potentiometer in terms of the concentration of component B.

If the other components of the mixture such as A, C, D, etc., have absorption wavelengths common with B, then their interference is compensated by putting a partial pressure of the interfering components into compensating cell Co and filter cells F. This makes the instrument sensitive only to variations in the concentration of B.

In both instruments the use of the null principle eliminates error from changes in amplifier characteristics, while it largely reduces the effect of variations in the radiation source.

The electronic circuits of the two instruments beyond the detectors are identical. The circuits are constructed in modular form with a unique circuit-checking device built in for field servicing. In the event of instrument failure the checking device locates the faulty component which then may be quickly replaced.

Both instruments will be supplied factory sensitized to specific problems, if desired.—Perkin-Elmer Corp., Norwalk, Conn.

#### Cycling Control Valve For Ion-Exchange

The Cycloflow valve was designed primarily for controlling cycles of flow in ion exchange equipment. All possibility of contaminating leakage is

is  
**coil-it is \***  
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your  
temperature  
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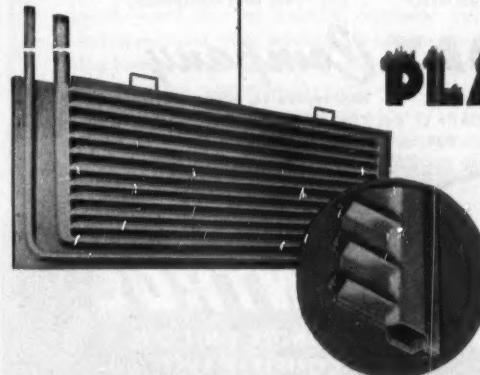


Here is a new treatment for solving your heat transfer problems that is as revolutionary as a new wonder drug. It stops coil-it is cold . . . It eliminates the many troubles that have plagued industrial heating and cooling practices due to the use of old-fashioned, outmoded pipe coils. This revolutionary new unit, called a Platecoil, heats or cools 50% faster and takes 50% less space in the tank. It simplifies maintenance and saves hours of downtime.

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#### PLATECOILS SAVE 50% IN HEAT TRANSFER COSTS

##### PLATECOILS COOL QUENCH OIL TANK FOR 1/3 THE COST



At the K-D Manufacturing Company, Platecoils are proving more efficient, yet cost only 1/3 as much to install. Ask about other case histories.

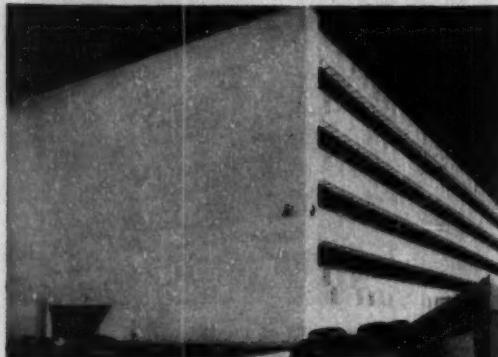
#### PLATECOIL REPLACES PIPE COILS



Coil-it is — Diagnosed as tank heating and cooling problems.  
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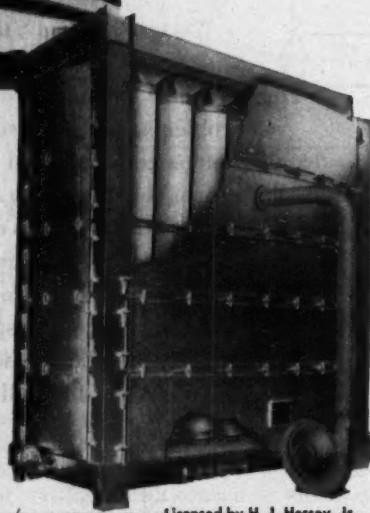
# 99.99+% PRODUCT RECOVERY SAVES MONEY FOR CHEMICAL PLANTS



DAY "AC" Dust Filters are reclaiming abrasive dusts with 99.99+% efficiency for the Coated Abrasives Division of Minnesota Mining & Manufacturing Co., St. Paul, Minn.

The DAY "AC" (Automatic-Continuous Operation) Dust Filter is the most important advancement in cloth dust filtering in over half a century. This dust filter provides high product recovery because the principle of operation permits the use of a better type of filtering felt than can be used in conventional dust filters.

The high product recovery feature of DAY Dust Control Equipment has created considerable interest throughout the chemical industry and we will be happy to send you names of companies using DAY equipment.



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tive and economical solution. DAY engineers are at your service for plant studies and cost estimates. Write to-DAY for New Bulletin. It will give you detailed facts and figures on the DAY "AC" Dust Filter and other DAY equipment.

**The DAY Company**

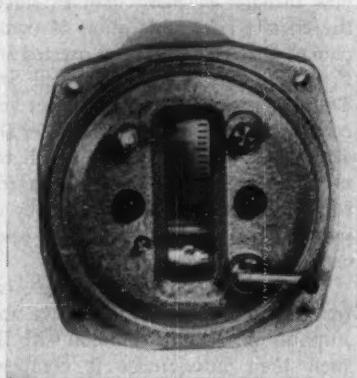
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EQUIPMENT NEWS, cont. . .

eliminated by providing an isolated section connected to waste between the outlet and all sources of contamination.

Manual or automatic operation can be used and a minimum of torque is required. Four double-acting pistons give positive valve action actuated by a simple, integral finger tip control. The design eliminates spring loading and large, unbalanced areas and flat surfaces which inherently result in leakage—American Water Softener Co., 330 West Lehigh Ave., Philadelphia 33, Pa.



## Pressure Meter Is Extremely Accurate

A new pressure measuring instrument, the Press-I-Cell, combines extreme accuracy with ruggedness and convenience of use. Pressure measurements are accurate within one part in 5,000, and sensitivity is one part in 15,000. The meter is compact, portable, temperature stable, and unaffected by vibration or mounting position.

The manufacturer emphasizes that the Press-I-Cell is not intended to replace standard instruments used in typical pressure measuring applications. Indicated uses are as a master laboratory instrument for calibrating other pressure sensing instruments, precision measurement of altitude or barometric pressure, liquid level gaging on large storage tanks, field tests requiring high precision or sensitivity with a compact test gage.

The pressure sensing elements of the instrument are two sets of extremely precise metal capsules. Movement resulting from the action of pressure on the capsules is translated through a follow-up mechanism to a final scale reading. The 600-in. scale

printed on 35-mm. film is rolled back and forth between two spools according to the pressure conditions acting on the capsules. A 2-in. portion of the scale is seen through the viewing window.

Scale movement can be either automatic by a servo mechanism or manual to a balance point indicated by lights.

The instrument can be equipped to operate over a wide range of absolute or gage pressures or differentials. Typical pressure ranges are 1 atmosphere absolute, 400 in. of water, and 150 in. of mercury differential. So sensitive is the instrument that it will measure drop in atmospheric pressure when it is raised 6 in. above the table on which it rests.—*Fischer & Porter Co., Hatboro, Pa.*

Saybolt chromometer has been redesigned to ease the job of color control on petroleum products. A revolving turret head eliminates color disk changes necessary in older models.—*Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.*

Signal relay unit is now constructed with LPG dustproof design which is less expensive than previous hermetically sealed units. Standard plug-in mountings are available in over one hundred standard circuits.—*Tigerman Engineering Co., 4332 Northwestern Ave., Chicago 18, Ill.*

Miniature speed changer has a lever speed control operating over 63-deg. arc. Speed changes cover a 25 to 1 range.—*Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.*

Gas analysis apparatus based on the soap film principle gives a complete analysis in three minutes. Accuracy is within plus or minus 0.1 percent. Instrument operates on a flowing gas stream.—*Griffin & Tatlock Ltd., Kemble St., Kingsway, London W. C. 2, England.*

Portable potentiometer indicator spots impending thermocouple failures, tests the operation of other pyrometer instruments, and checks equipment such as heating units and test furnaces. Accuracy is 0.25%. Instrument measures  $9\frac{1}{4} \times 9\frac{1}{4} \times 6\frac{1}{4}$  in. and weighs 14 lb.—*The Foxboro Co., Foxboro, Mass.*

—End

**No Contamination  
... and Positive  
control of  
pumping volume**

**Lapp**  
*Auto-Pneumatic*  
**PULSAFEEDER**

Reciprocating piston action provides positive displacement. But piston pumps only a hydraulic medium. Diaphragm does no mechanical work—acts only as floating, balanced partition, isolates chemical being pumped from working pump parts—eliminates need for stuffing box or running seal. Pumping speed constant—volume variation results from variation in piston-stroke length. In Auto-Pneumatic models, pumping rate precisely controlled by instrument air pressure responding to any instrument-measurable processing variable. The Lapp Pulsafeeder is successfully handling almost all highly corrosive and "hard-to-handle" chemicals, against pressures up to 2,000 lbs.

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No. 300, just issued. 24 pages of description, specifications, typical applications, flow charts. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 737 Maple Street, Le Roy, N. Y.

# Product News

Edited by Frances Arne.



AMAZING WEAR resistance for conveyor belts—just one hope for new type rubber.

## Maybe Tires Will Outwear Autos

. . . this is well within the realm of possibilities offered by the impressively superior toughness and resistance to abrasion of a new rubber substitute

Goodyear's tests on its new rubber substitute, a polyester, show that (1) tire treads made of it achieve from two to five times more wear resistance than those of the best cold rubber produced; (2) it is equivalent to butyl rubber in air diffusion resistance; (3) equivalent to neoprene in oil resistance.

In resistance to oxidation, too, it was found to be far superior to natural or to any other man-made rubbers. Tensile strength is described as 50 to 100 percent better than other types of rubber-like material. Vulcanization time on tires made of the product can be cut in half.

To make the synthetic, ethylene glycol and propylene glycol are mixed in open vessels with adipic acid. To the resulting polyester base is added di-isocyanate. The latter functions as a control on the solidifying reaction of the other chemicals. With proper amounts of di-isocyanate, the final material is in an optimum state for further processing on mills, calendars, extruders and other conventional rubber equipment.

► Secret of Development—This tech-

nique for slowing down the polymerization makes the big difference between Goodyear's product and Germany's recently announced Vulcollan. Though they are chemically similar, Vulcollan solidifies so fast that it must be molded into the finished product right after it's chemically composed.

The Goodyear rubber can, when necessary, be given a second di-isocyanate treatment and formed into final shape without the use of sulphur or accelerators for vulcanization. Carbon black and other reinforcing agents may be used—although as far as stock-toughening is concerned, it's a little like gilding the lily.

► The Minus Values—Although the plus values of the new development cannot fail to excite high hopes, there are still big problems to face before commercial production can be thought of. For one thing, the product's qualities of resilience and adhesion must be improved. While it takes to metal, it resists bonding to other rubbers. This is a major drawback since the material would probably be most useful as a tough, comparatively thin skin on tire treads.

There is still a long way to go to develop acceptable processing methods. Though it's less expensive than Vulcollan, it would still cost over twice as much, even on a commercial scale, as American GR-S for tires. And no way has been found yet to procure the right di-isocyanates at reasonable cost.—Goodyear Tire & Rubber Co., Akron 16, Ohio.

## Gallium

Commercially sold and publicized for over two years, the "use-wanted" sign is still out.

Alcoa, which started selling gallium metal over two years ago, is still trying to find a market for it that will bring its price below \$1,000 a lb.

The metal's unique and promising properties include a melting point of 86 deg. F., a boiling point of over 3,600. It expands upon solidification. It shows marked differences in electrical resistivity and coefficient of thermal expansion along the direction of the three axes of its crystallographic structure. Its electrical resistivity variability is believed greater than for any other metal. It emits electrons at extremely low temperatures. Thus, combining its unique properties, gallium is truly one of the unusual elements.

Despite all this, the pounds of gallium so far actually used commercially in any one year could be counted off on your fingers. Maybe you can use it?—Aluminum Company of America, 801 Gulf Bldg., Pittsburgh 19, Pa.

## Lubricant

Chemical said to outperform grease in many industrial and automotive functions.

A stable chemical compound without a soap base is said to adapt itself to almost any stress or temperature. Called Plastilube, it is said to resist breakdown, and melting and freezing. And it displays excellent adhesiveness in boiling water and retains its pumpability at low temperatures.

Its principal suggested use is for lubrication of bearings where temperatures vary from below freezing to more

than 500 deg. F. The manufacturers also point out that it satisfies the need for a stable lubricant for use in centralized systems. It will not, they state, break down or separate in the orifices, lines and valves.—Warren Refining and Chemical Co., 750 Prospect Ave., Cleveland, Ohio.

## Silicone Rubber

Remains flexible at -120 deg. F.; resists heat to 500 deg.

New SE-550 silicone rubber is believed to have the lowest change in bending modulus of any commercially available elastomer. It shows less than 25 points durometer increase from 500 deg. F. down to -120 deg. F. The brittle point is actually well below -120. It is said to outperform all other silicone rubbers at any low temperature while still retaining the heat resistance up to 500 deg. of most other silicones.

The new compound is easily worked by rubber fabricators, according to the manufacturer. It is removed from the container with no difficulty, mills and extrudes easily, and has good tear strength that permits stripping from hot molds.

Versatile also as a base stock, SE-550 can be used by fabricators to produce different compounds with higher durometer and lower compression set. It can be colored with a wide range of heat-stable pigments.

It is expected to find wide application for gaskets and seals on fuselage equipment of high-flying aircraft as well as for wire insulation on ignition systems of arctic ground equipment.—General Electric Co., Pittsfield, Mass.

## Trichlorobenzenes

Three pure isomers of potential use in cancer research, fungicides and in rodent repellents.

Solvay's unique pilot plant for the separation of pure isomers is now producing 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and 1,3,5-trichlorobenzene. They are being offered in experimental quantities with a purity range of 99 percent or better.

Although superficially related, each has its own individual chemical personality. These variations have been

## IN BRIEF—A capsule listing of this month's newsworthy products

	See Page . . .
<b>It's New . . .</b>	
Rubber Substitute	262
Gallium	262
Lubricant	262
Silicone Rubber	263
Trichlorobenzenes	263
Citrazinic Acid	263
Molding Compound	263
Resin	263
Dimethyl Isophthalate	263
Fuel Oil Additive	263
Adhesive	264
Resin Coating	264
Resin	264
Seamless Capsules	266
High Boiling Phenols	266
Polyvinyl Acetate	268
Resin Dispersion	270
Heat Sealing Compound	270
Metallic Phosphates	272
Ammonium Salts	272
	Deodorant-sanitizers
<b>It's Good for . . .</b>	
Long-wearing tires, conveyor belts	262
Its unique, as yet unexploited, properties	262
Bearings subjected to wide temperature variations	262
Its superior resistant to heat and cold	263
Use in cancer research, fungicides	263
Dye intermediates, pain-killer	263
Applications requiring high shock resistance	263
Production of clearer, truer castings	263
Tougher protective coatings and laminating resins	264
Preventing filter clogging in oil burners	264
Bonding porous to nonporous surfaces	264
Sealing dust of concrete walls	264
Clear, light-stable films and sheeting	266
Quicker-dissolving medicinal and food products	266
Manufacture of resins, dyestuffs	268
Thickening textile sizing and coating compositions	270
Pressure-sensitive adhesives	270
Sealing glass units	272
Corrosion inhibitors in cooling water systems	272
Deodorant-sanitizers	272

used to help determine the action of different chemical structures in such fields as laboratory work on cancer research, fungicides and rodent repellents.

In addition to the physiological use, these new materials are expected to find industrial and agricultural uses in many applications where mixed isomers are unacceptable. They are also expected to find use as solvents in dye-stuff synthesis and in the preparation of bactericidal soaps and solutions as well as in the field of photographic and leather processing chemicals.—Solvay Process Div., 61 Broadway, New York 6, N. Y.

## Citrazinic Acid

Active as a coupling agent, it has potential as a dye intermediate; also has pain-killing possibilities.

Pfizer is now operating a pilot plant which is turning out citrazinic acid in lots of up to 5,000 lb. Selling price is \$2.80 a lb. The pyridine-base compound is a derivative of citric acid, also Pfizer-produced.

Most obvious commercial potential of the compound is as an intermediate for dyes and drugs. It's an active coupling agent and can be linked to diazotized aromatic amines to yield a broad range of monoazo and diazo reds, oranges and yellows. Reactions involving the compound's hydroxyl or carboxyl groups may be used to produce an even wider selection of azo colors.

Of interest to the pharmaceutical field: several azo derivatives are promising antiseptics; dialkoxy derivatives of the acid make potent local anesthetics. And the acid itself can serve as a stepping stone to the isoniazid

anti-TB drugs. It also has pain-killing possibilities.

Pfizer is also hoping eventually to rouse interest for a CZA in metal treatment, coating compositions and agricultural chemical production.—Chas. Pfizer & Co., 630 Flushing Ave., Brooklyn, 6, N. Y.

## Molding Compound

High-impact glass-fiber-filled phenolic can replace metals in some applications.

New Durez 16221 Natural consists of phenol-impregnated fibre-glass rovings in standard one-inch lengths.

It was formulated for applications where high shock resistance is required. Because of its mineral filler, it is claimed that it can be used at temperatures where cellulose-filled impact compounds would be unsatisfactory.

It is said to have excellent dimensional stability and a high modulus of elasticity. These properties in combination with the high strengths available will, it is believed, open up new fields of application which heretofore required the use of metals. This material is readily molded by standard compression methods.—Durez Plastics & Chemicals, Inc., North Tonawanda, New York.

## Resin

Eliminates clay balls from foundry sand to allow production of truer, cleaner, castings.

Extensive foundry tests have shown that the new material, Lustrex 886, improves sand workability, flowability and packability. This permits uniform packing which eliminates most of the

cracks, fissures and soft spots characterizing untreated sands.

Effective in small concentration, one pound of the new material is said to produce uniform clay distribution in one ton of foundry sand.

In foundry tests to date, sand treated with Lustrex 886 has upgraded castings of steel, malleable iron, grey iron, phosphor bronze, aluminum and magnesium.

Initially Lustrex 886 will sell for \$1.10 per pound. However, only about one-sixteenth of the resin is burned out each time the sand is used. This means that only one-sixteenth of a pound of Lustrex 886 must be added to a ton of sand each time it is recycled.—Monsanto Chemical Co., Springfield, Mass.

### Dimethyl Isophthalate

Now produced at low cost, it can offer benefits to makers of plasticizers, alkyds, polymers.

Plastics and protective coatings will probably be the most important applications for the new commercially available chemical, dimethyl isophthalate.

The product is isophthalic acid in the form of its low-melting, easily processed methyl ester. Research men have recognized that isophthalic acid offers advantages over phthalic anhydride in the preparation of plasticizers, alkyds, and polymers; but it has never been available in any quantity at prices that would permit its commercial use, or even at a low enough price to stimulate research towards its application in industry.

Some of the advantages indicated by the new material include plasticizers with improved low-temperature efficiency and lower volatility; tougher, longer-lasting protective coatings based on oil-modified alkyd resins; and improved toughness in laminating resins.

The product is being produced by Hercules Powder Co. in a large-scale pilot plant with an ultimate monthly capacity of 200,000 pounds. A unique process for oxidation of xylenes is being used.

The unique part of the original process is that the oxidation is carried out to high yield under mild conditions. Neither chemical oxidants nor high pressures and temperatures are required. And low-cost xylene fractions are used as raw materials. This

brings production costs down to where, in full-scale commercial operation, it is anticipated that prices could be directly competitive with phthalic anhydride.

Another product which is being made concurrently in the pilot plant is DMT (dimethyl terephthalate). DMT, more expensive than DMI, is a raw material for fiber- and film-forming polyesters.—Hercules Powder Co., Wilmington, Del.

### Fuel Oil Additive

Prevents screen and filter clogging in oil burners.

A new nonmetallic base compound called Santolene H is said to overcome operation difficulties caused in oil burners by screen and filter clogging. It does this via a three-way action.

1. By inhibiting progressive polymerization of unstable elements in the oil, it maintains a low level of fuel of sludge and sediment. Normally, expensive acid treatment can be eliminated by the use of Santolene H.

2. By a unique surface action, it substantially eliminates the deposition on burner parts of such sludge and sediment as may be present in the oil.

3. By inhibiting rust, it largely does away with the presence of entrained rust at the burner.

Diesel engine tests on fuels treated

with Santolene H indicate that identical benefits result without harmful effects to engine operation or deposits.

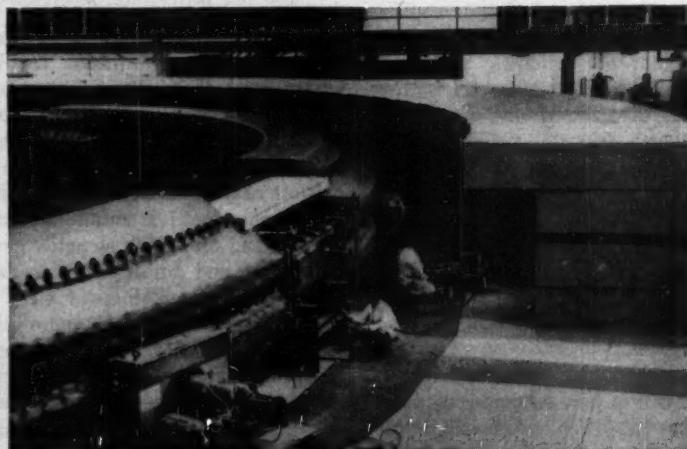
Furthermore, the new material does not contribute to the formation or stabilization of fuel oil-water emulsions and the attendant oil haze. It has substantially no effect on the carbon residue of fuel, an important consideration when fuels are to be used in rotary vaporizing type burners. And Santolene H is not subject to depletion by water extraction or reaction with water.—Monsanto Chemical Co., St. Louis 4, Mo.

### Adhesive

For waterproof bonds between porous and non-porous surfaces.

Bonding of aluminum, stainless and porcelain-enamelled steel to wood, honeycomb, and plastics are said to be the special province of new Syncro 925. The product is described as a thermosetting copolymer emulsion. Producing tough, flexible films, it is recommended for applications where heat, water, and solvent resistance are required.

With room temperature cure, joints normally may be handled within one half to three hours after glue-up. With heat, cure can be effected in a few minutes.—Snyder Chemical Corp., Bethel, Conn.



RESIN COATING SEALS IN CONCRETE WALL'S ABRASIVE DUST

The series of 10-ton concrete blocks which shield the giant cosmotron at Brookhaven National Laboratory, Upton, N. Y., are coated with a  $\frac{1}{8}$  in. layer of a polyester resin called Vibrin. The coating prevents them from causing dust which would damage the \$8 million worth of delicate mechanism. United States Rubber Co., Rockefeller Center, New York 20, N. Y.



## "Sweet solution" to a filtration bottleneck

Gearing sugar production to meet ever-increasing demands is a problem that the sugar industry actually solved years ago when they eliminated filtration bottlenecks by starting to use Celite\* filter powders.

Sugar refiners found that pressure filtration, using Celite, completely removed colloidal matter at high flow rates for long, uninterrupted cycles.

Celite's ability to do an exceptional filtering job can be attributed to these

important factors which make it unique among filter aids:

Carefully processed from the purest deposit of diatomaceous silica known, Celite is available in nine standard grades—each designed to trap out suspended impurities of a given size and type. Whenever you reorder, you are assured of the same uniform, accurately graded powder received in your initial order. Thus, with Celite, you can count on consistent clarity in your

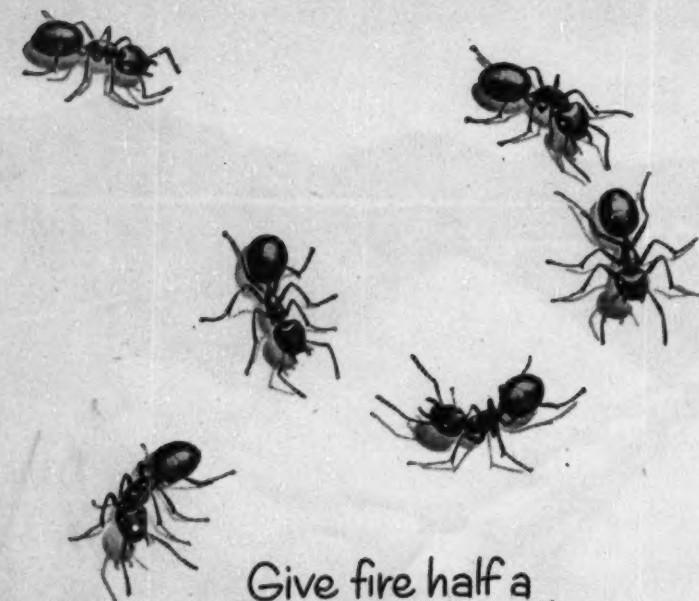
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### Resin

No unfused resin particles mar clarity of sheet milled at low temperature from new resin.

A general purpose, straight vinyl material having an approximate intrinsic viscosity of 0.8 is the newest addition to General Tire & Rubber's series of Pliovic polyvinyl chloride resins.

Called Pliovic G80V, the product has processing temperature requirements of 20 to 40 deg. F. This low fusing temperature combined with its thermal stability permit rapid calendering and extrusion. Both clear and pigmented products are said to benefit from the resin's excellent light stability and good color.

The nature of the resin recommends it for use in calendered fabric, film and sheeting. Its unusual ability to run easily on three rolls of a standard calender has been demonstrated in production trials. Soft stocks are easily compounded for fabric coatings.

Now available in commercial quantities, the resin is priced at 38 cents per pound in truckload or carload lots.—Goodyear Tire & Rubber Co., Akron 16, Ohio.

### Seamless Capsules

New process makes fast-dissolving capsules which have 50-75 percent less shell material.

A flotation process is being used to produce capsules having a thin, one-piece, seamless shell. The product which requires 50-75 percent less shell material than conventional types, has greater solubility. This factor is of

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2,2 Diethyl-1,3-Propanediol	Triol 230
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For further information on propylene glycol or any CARBIDE chemical, write for your copy of "Physical Properties of Synthetic Organic Chemicals" (F-6136) or the "Glycols" booklet (F-4763). Offices in principal cities—in Canada: Carbide and Carbon Chemicals, Limited, Toronto.

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PRODUCT NEWS, cont. . .

prime importance in using capsules containing peppermint, lemon and other oil flavors for food. And it is desirable in capsules for medicinal and other fill materials.

The new process uses no dies of any sort. Accurately measured globules of the clear oil fill material are injected into a liquid shell solution. As the globule rises the shell material coats it, forming a strong though seamless capsule. By mechanical means the capsule is freed from the gelatin shell material and rises to a cooling, carrier liquid, after which it is deposited in a container, later to be dried and processed at pre-determined degrees of temperature and humidity.

The process is flexible enough to produce capsules ranging in size from one-half to fifteen minimis. At present, due to the limitation of design of the present equipment, the capsules are limited to fill materials having a specific gravity not exceeding 1.0. The manufacturer is equipped to produce in excess of 2 million capsules a week.

Present production includes capsules of essential oils, fish liver oils and vitamin, medicant, deodorant and perfume oils.—Gunnell Capsulations, Inc., P. O. Box 163, Fraser, Mich.

## High Boiling Phenols

Offer greater reactivity with formaldehyde in the synthesis of thermosetting resins.

High boiling phenols, the first product from coal hydrogenation to be offered to industry, is now available in tank car quantities. This new product is a semi-refined mixture of short-chain alky-substituted phenols with a distillation range between 230 and 270 deg. C.

Compared with phenolic materials of similar boiling range derived from other sources, high boiling phenols has a high degree of meta substitution. This gives it greater reactivity with formaldehyde in the synthesis of thermosetting resins. Such resins can be made from high boiling phenols alone without the addition of m-cresol or phenol.

A soluble oil that has good germicidal properties can be made from high boiling phenols, neutral oils, and emulsifiers.

Its general reactivity suggests the use of high boiling phenols as an inter-





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PRODUCT NEWS, cont. . .

This lightweight, rigid block insulation, effective up to 1700° F. eliminates the need for separate high and low temperature materials. Its low thermal conductivity helps maintain proper operating temperatures in steam boilers, refinery towers, ovens, chemical treating tanks and other hot equipment.

B-H Mono-Block is stable under severe heat and moisture conditions. And finished with B-H Powerhouse Cement (which also insulates) it provides long lasting insulation with permanent high efficiency. When heat losses have you worried, get in touch with B-H Engineered Insulation Service. No obligation at all.

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mediate in the manufacture of phenolic resins, phenolic dyestuffs, and in chemical syntheses where ring substitution on a phenol is indicated.—Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.

### Polyvinyl Acetate Copolymer

For thickening textile sizing and coating compositions.

A new colloidal water-dispersion of a polyvinyl acetate copolymer deposits films of exceptional clarity and water resistance. And despite the fact that the films are water resistant, they may be readily dissolved in dilute alkalis or ammonia.

This latter property is valuable for treatment of paper products, non-woven fabrics, etc., since the fiber may be recovered by an alkaline treatment. For textile finishes, the use of metal salts to insolubilize the free carboxyl groups will help to render such finishes resistant to removal by alkaline builders during laundering.

In general the product, called Polyco 497, may be used for the same type applications as the conventional polyvinyl acetates. The film properties approach those of the solvent solutions, and for many applications Polyco 497 may be used to replace solutions.—American Polymer Corp., Peabody, Mass.

### Resin Dispersion

Combined with other resin dispersions, it improves adhesion of synthetic fibers to glass.

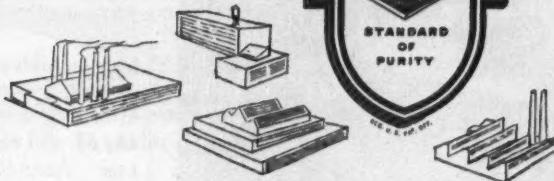
Polyco 426 is a new type linear terpolymer in aqueous dispersion. It is said to deposit soft, tacky films which show excellent adhesion to rayon, nylon and other synthetic fibers. Tertiary amine groups attached to the main polymer chain get the credit for these adhesive properties.

Addition of Polyco 426 to other resin dispersions, such as butadiene-styrene latices, improves their adhesion to synthetic fibers and glass. Its permanent tackiness suggests its use as a pressure-sensitive adhesive. In mixtures with water-soluble resorcinol-formaldehyde resins, it markedly increases the adhesion of synthetic latex films to synthetic fibers.

An anionic dispersion stable to normal mechanical handling, it is



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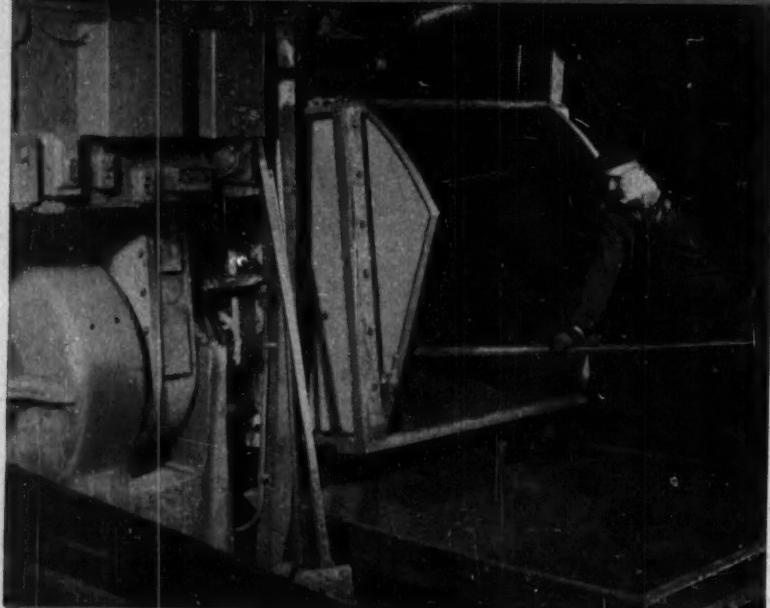
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## PRODUCT NEWS, cont. . .

stable at alkaline pH, but the emulsion is broken by addition of acids. With a total solids content of 38 percent, its viscosity at 25 deg. C. is 10 to 20 cps. It should not be subjected to freezing temperatures which may cause irreversible coagulation.—American Polymer Corp., Peabody, Mass.

## Heat Sealing Compound

Synthetic wax gives it high melting point and chemical resistance.

A new heat sealing compound does not exhibit cracking or flaking at -45 deg. F. although it has a high melting point (cold flow, 210 deg. F. min.). It owes this combination of properties to its content of Acrawax C, a synthetic wax with a melting point of 284-290 deg. F.

The noncorrosive sealing compound prevents leakage of air and moisture. It is especially recommended for sealing glass units.—Glyco Products Co., 26 Court St., Brooklyn 2, N. Y.

Metallic phosphates have been found to make superior corrosion inhibitors in cooling water systems, steam boilers, oil well equipment and car radiators. According to a speaker at a recent ACS meeting, these compounds, which are byproducts of the phosphates industry, are also useful in the control of algae and slimes caused by bacteria and in breaking up emulsions of water and oil. Possible applications to fields far removed from water treatment were also suggested because the metallic phosphates have been successfully manufactured with strontium, calcium, barium, lead cadmium, magnesium, copper, antimony, manganese, molybdenum, vanadium, silicon, iron and aluminum.—Deadly Chemical Co., Kansas City, Mo.

Superior wetting action is among the improvements claimed for two new quaternary ammonium salts. Designed for use as deodorant-sanitizers, these products have higher phenol coefficients than the company's Onyx BTC to which they are closely related. One of the products, an alkyl dimethyl ethylbenzyl ammonium chloride is called BTC 471; the other, an alkyl dimethyl dimethylbenzyl ammonium chloride, BTC 927.—Onyx Oil & Chemical Co., 181 Warren St., Jersey City 2, N. J.

# Streamlined FOR SMOOTH, EVEN FLOW OF STEAM, WATER, AIR, OIL, ETC.



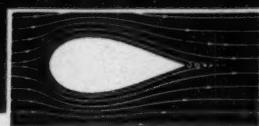
No detour around a  
dividing wall



No right angle directional change  
in flow because of a seat wall



No valve stems, springs or  
other parts to break up flow



## TURBULENCE ELIMINATED

The streamlined or straight line flow such as the above pattern shows eliminates turbulence, giving highest valve capacity. There are no complicated parts to get out of order and no small ports or passages to clog up. There is only one vital moving part, the seat piston, which is opened in a positive manner by the force of the initial pressure and closed in an equally positive manner by the force exerted by the delivery pressure on the diaphragm.

Supply line pressure may change, demand may change, but you still have smooth action and close dependable regulation.

Ask for Bulletin "962" that explains the reasons for such performance as maximum pressure when it is needed most and accurate pressure control.

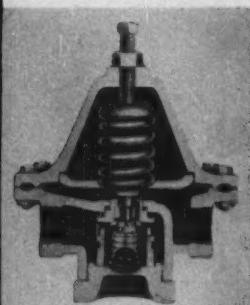
**CASH STANDARD**

CONTROLS...  
VALVES

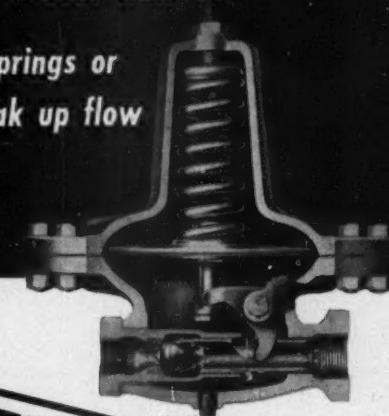
**A. W. CASH COMPANY**  
**DECATUR, ILLINOIS**

BULLETINS  
AVAILABLE  
ON OTHER  
**CASH STANDARD  
VALVES**

Send for them

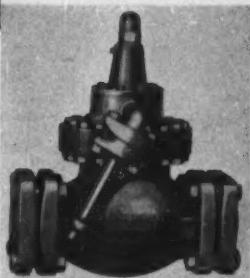


Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.

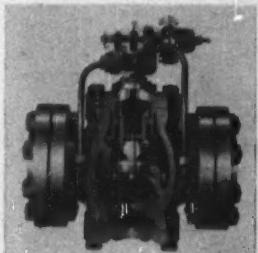


**CASH STANDARD**  
*Streamlined*  
**REDUCING VALVE**

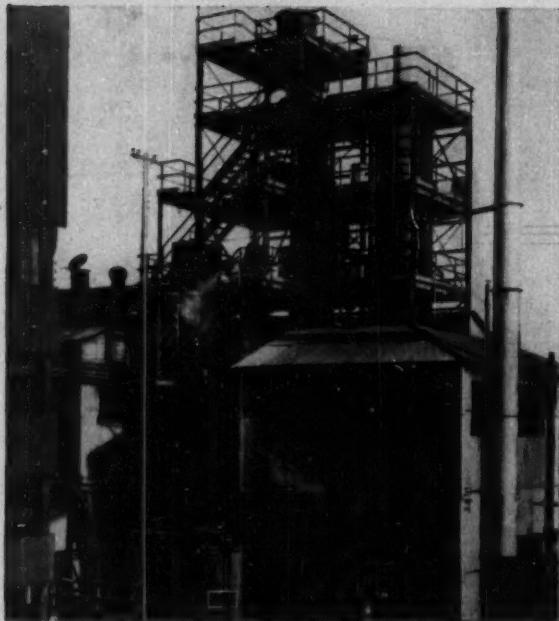
TYPE 1000  
PRESSURE



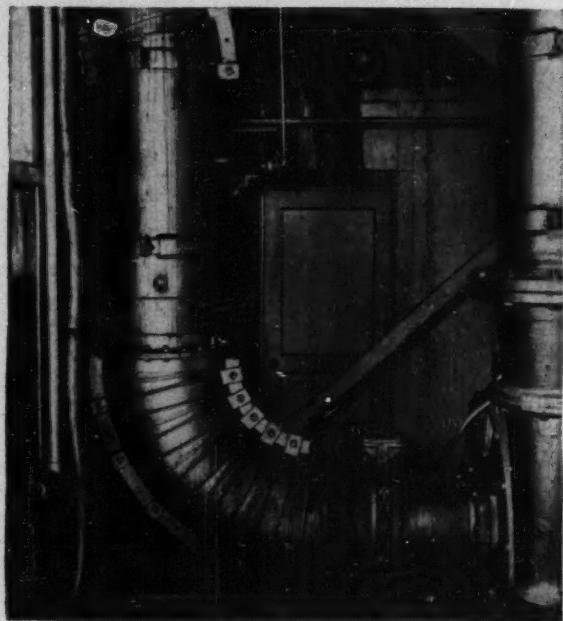
Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.



Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.



UNIT at Selby, Calif., where AS&R recovers and purifies SO<sub>2</sub>.



DUCT which brings sulfur dioxide from roasters to the unit.

## Hi-Purity Liquid SO<sub>2</sub> From Roaster Gases



Liquid sulphur dioxide of 99.9975 percent purity is now being manufactured on a commercial scale by the absorption-desorption process using byproduct roaster gases as the sulfur dioxide source and dimethylaniline as the absorption medium.

First put into commercial operation in the fall of 1947, this new process successfully utilizes chemical and antimonial lead as the chief materials of chemical construction. Lead is used in this instance for its excellent resistance to the corrosive characteristics of sulfur dioxide in combination with dimethylaniline. Of particular interest from the viewpoint of both design and performance are the lead heat exchanger coils.

There are two plants for extracting pure sulfur dioxide from impure dilute roaster gases by dissolving the dust-free gas in dimethylaniline: the Selby, Calif. plant of the American Smelting and Refining Co. and the Copperhill, Tenn. plant of the Tennessee Copper Co. The pictures accompanying the flowsheet are of the Selby installation.

Process was developed and patented by E. P. Flemming and T. C. Fitt both of American Smelting and Refining (Patents No. 2,295,587 and 2,399,013) and has been licensed to the Tennessee Copper Co.

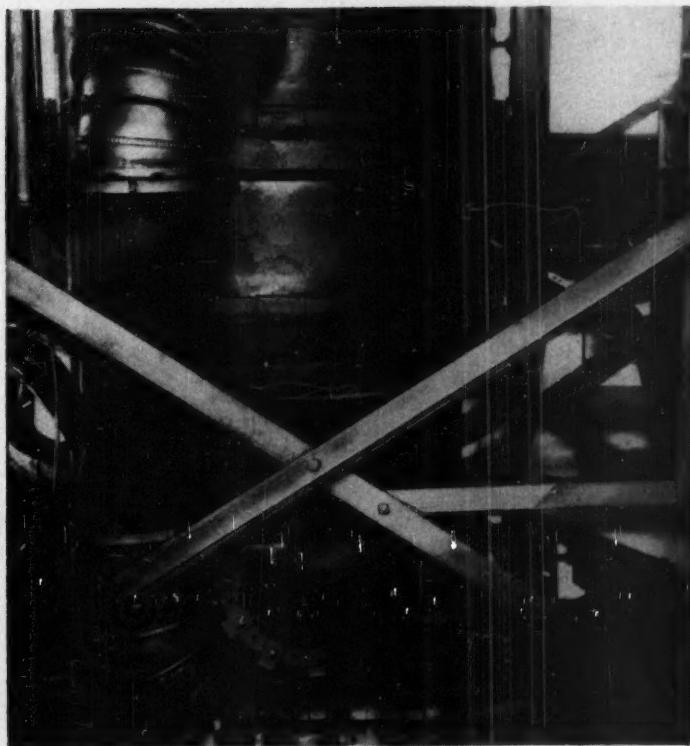
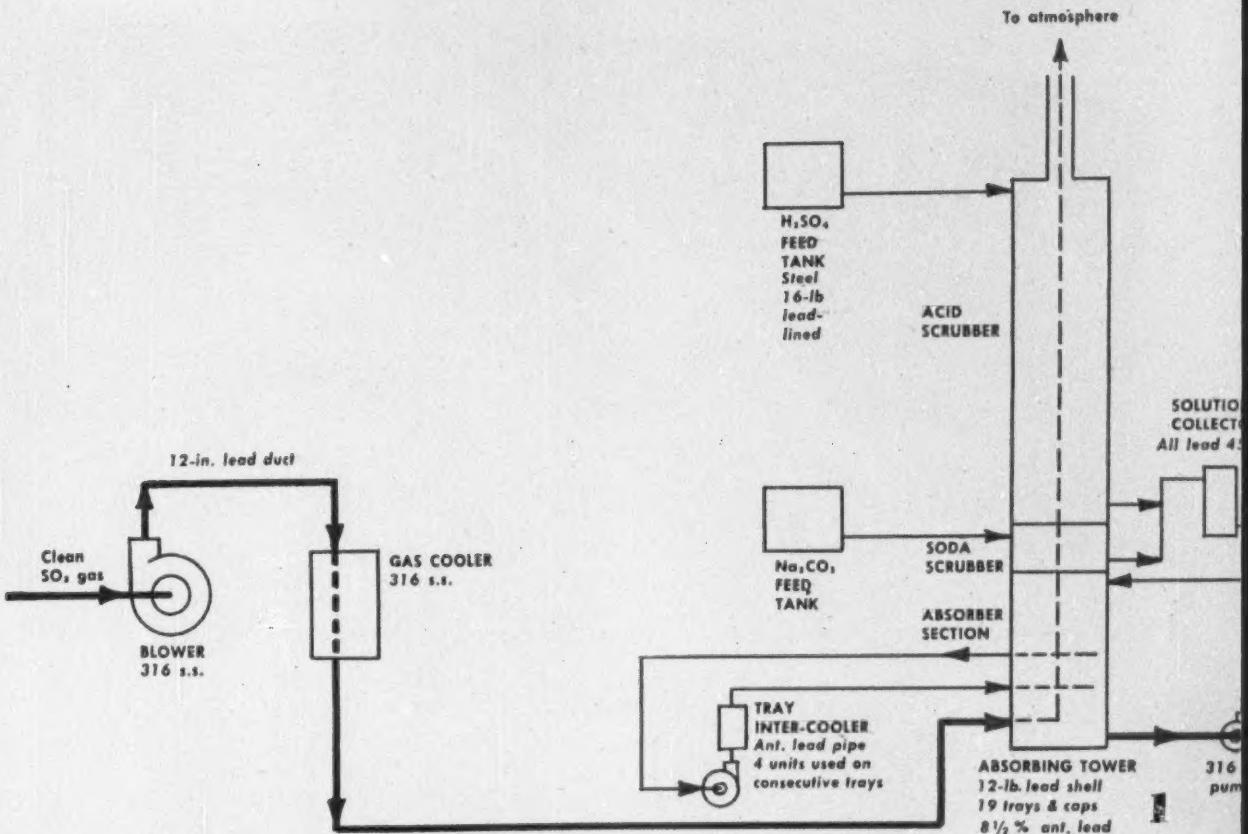
In the course of partially converting sulfide ore concentrates by roasting prior to smelting, a considerable quantity of sulfur dioxide gas is produced. Part of this gas is conveyed to the sulfur dioxide plant. After cleaning to remove excess solid foreign material, the gas enters an absorbing tower consisting of a series of bubble caps which force the gas into intimate contact with dimethylaniline,

a weak organic base capable of dissolving sulfur dioxide. The quantity of gas that may be dissolved in the DMA depends upon the temperature—the cooler the liquid, the greater the quantity of gas dissolved. Conversely, when the liquid is heated the gas is expelled. During absorption the DMA liquid changes color from yellow to ruby red, increases in temperature and so must be cooled at intervals by re-circulating through a water cooled lead pipe coil situated outside the tower.

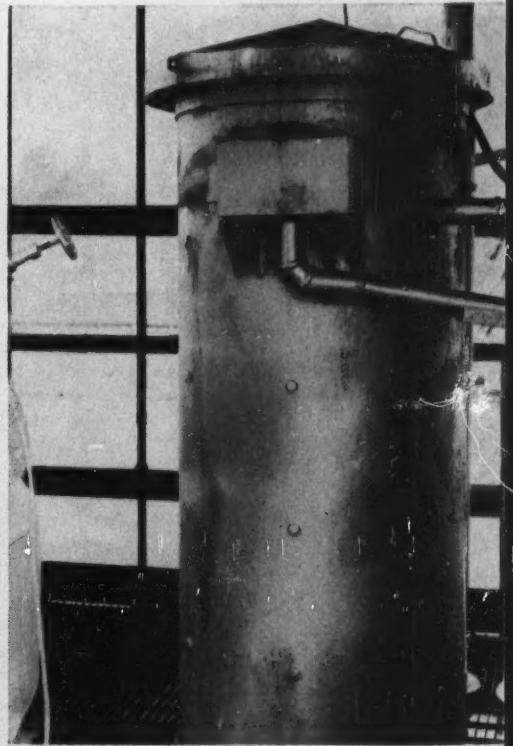
After the dimethylaniline passes through the absorbing tower it is essentially saturated with sulfur dioxide.

To raise the temperature of the pregnant liquid before sending it to the stripping tower is economically advantageous. This is accomplished by passing it through heat exchanger coils which serve a dual purpose: one to preheat the liquid before going to the stripping tower, thus saving steam, and the other to cool the stripped liquid from the stripping tower. The pregnant liquid is thus preheated in the heat exchanger, then passes through the stripping tower, where it is heated by indirect steam heat, and denuded of its sulfur dioxide content. The heated, stripped DMA liquid leaving the stripping tower passes back through the heat exchanger, where it is cooled before re-entering the absorbing tower. The sulfur dioxide from the stripping tower passes through a third bubble cap tower where concentrated sulfuric acid reduces its water content to less than 25 ppm.

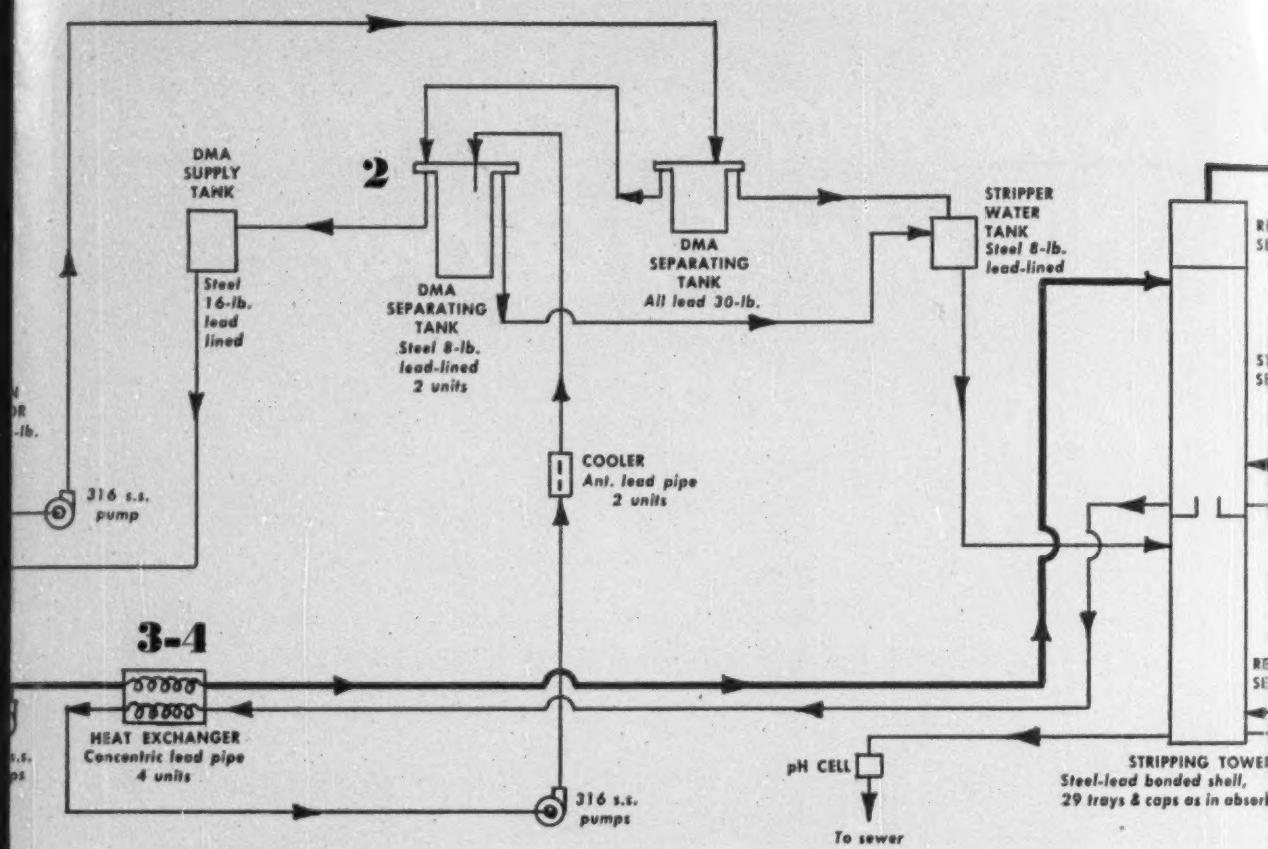
The gas now 99.9975 percent pure passes to a compressor where it is liquified under pressure of 40 to 50 psi. and stored in a large steel tank. Shipment from the plant is made in tank cars and in smaller containers.



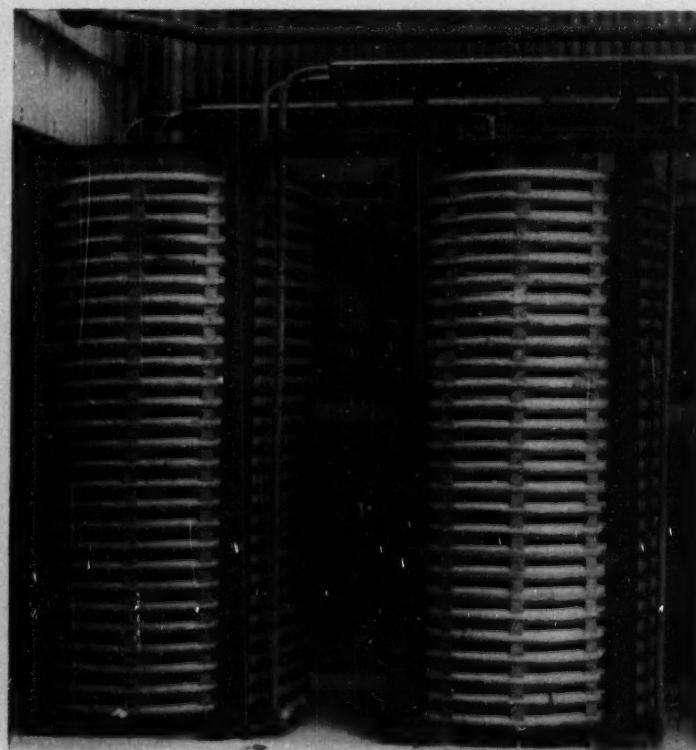
**1** Absorbing tower base with lead duct entering bottom. Dimethylaniline, the absorbent, becomes essentially saturated with sulfur dioxide.



**2** Dimethylaniline separating tank where dimethylaniline water going to the stripping tower (stripping water).



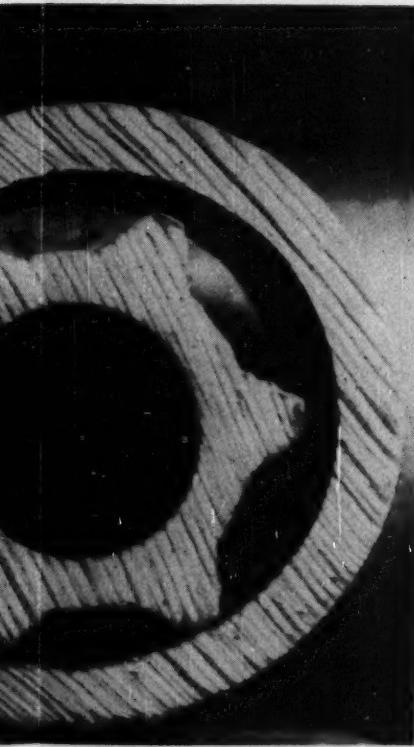
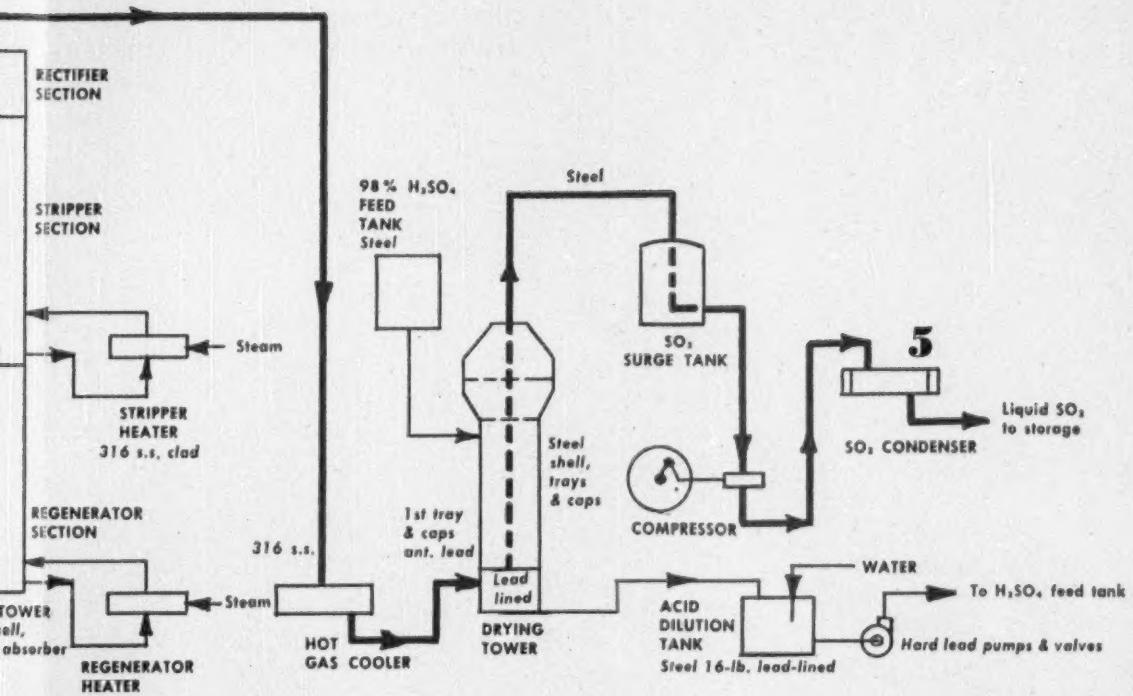
line is separated from



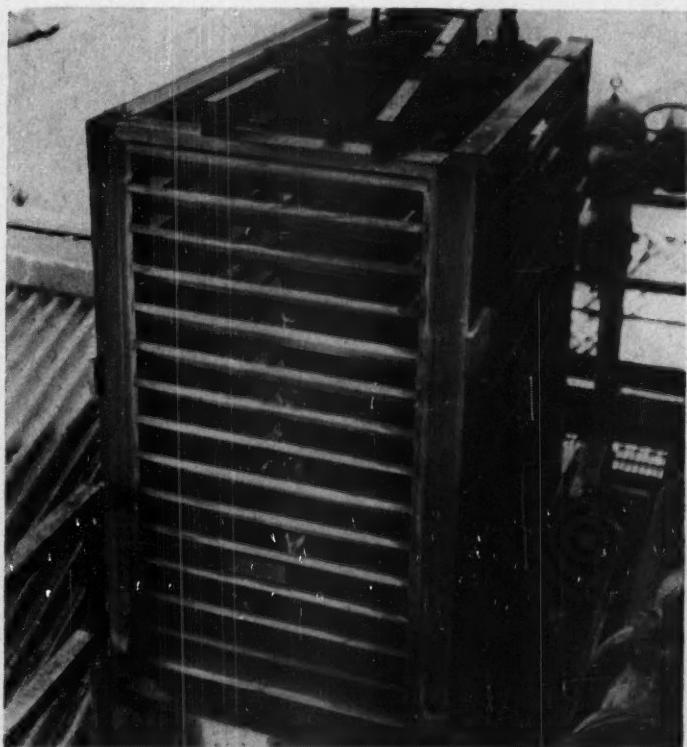
**3** Heat exchanger coils preheat the feed to the stripping tower, and cool the effluent from the stripping tower.



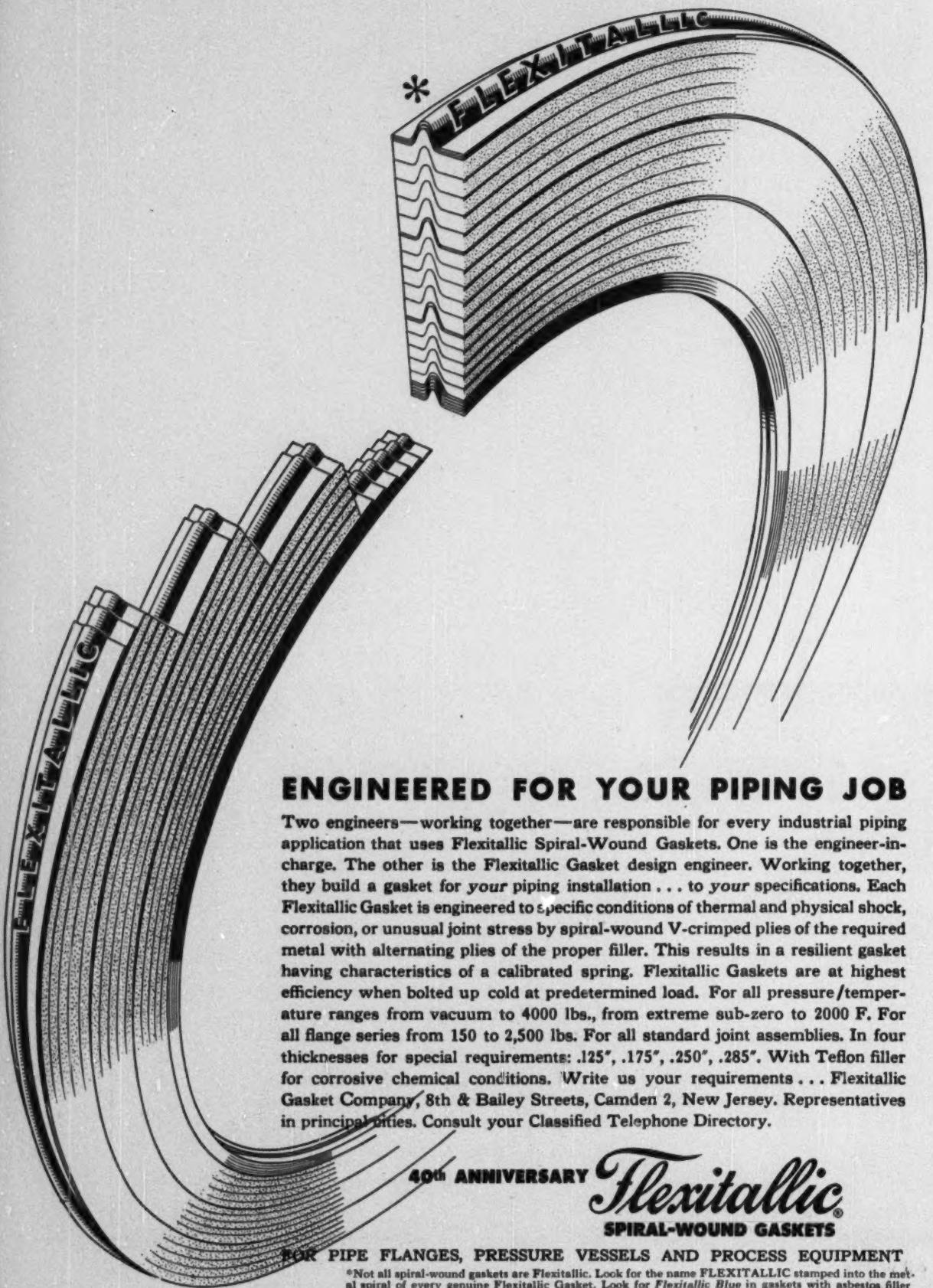
**4** Cross-section of heat exchange lead pipe within another, perm



Heat exchanger coil shows one specially-shaped extruded permitting countercurrent flow.



5 Condenser liquefies the sulfur dioxide which has been compressed under pressures of 40 to 50 psi. It is 99.9975 percent pure.



## ENGINEERED FOR YOUR PIPING JOB

Two engineers—working together—are responsible for every industrial piping application that uses Flexitallic Spiral-Wound Gaskets. One is the engineer-in-charge. The other is the Flexitallic Gasket design engineer. Working together, they build a gasket for your piping installation . . . to your specifications. Each Flexitallic Gasket is engineered to specific conditions of thermal and physical shock, corrosion, or unusual joint stress by spiral-wound V-crimped plies of the required metal with alternating plies of the proper filler. This results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at predetermined load. For all pressure/temperature ranges from vacuum to 4000 lbs., from extreme sub-zero to 2000 F. For all flange series from 150 to 2,500 lbs. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

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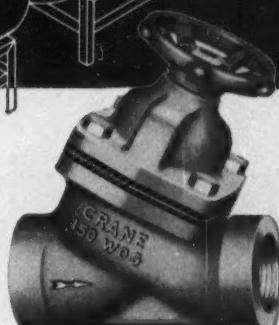
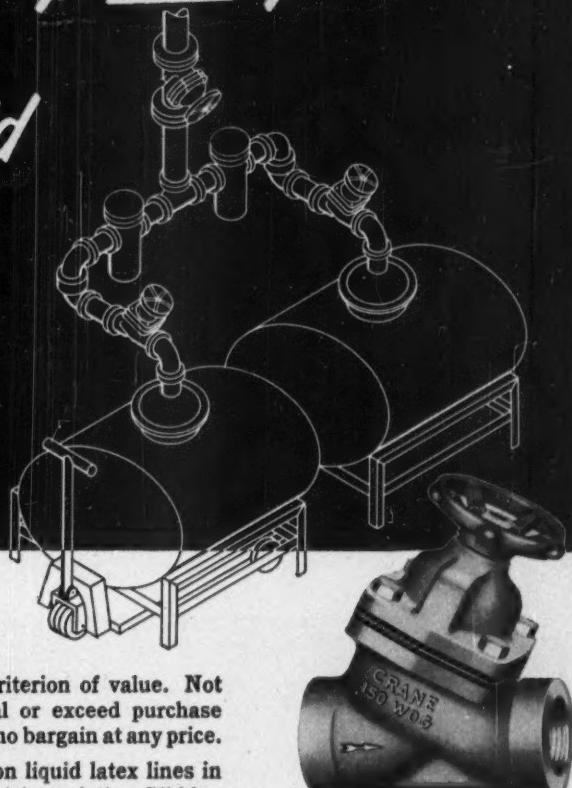
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# *It's not what you Pay for Valves ... it's what they Cost you*

*on Sticky Fluid  
for instance*

*(A Case History)*



What you pay for valves is not the final criterion of value. Not when maintenance costs can quickly equal or exceed purchase price. And a valve that hinders production is no bargain at any price.

Take the case of valves formerly used on liquid latex lines in a paint factory—the Adams & Elting Division of the Glidden Company, Chicago. The valves were conventional design with working parts exposed to fluid. The sticky latex accumulated and congealed in the bonnet and stem threads. Too often, the valves were inoperable, forcing frequent costly maintenance with costlier production delays.

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Crane Packless Diaphragm Valves,  
made with iron, brass, aluminum,  
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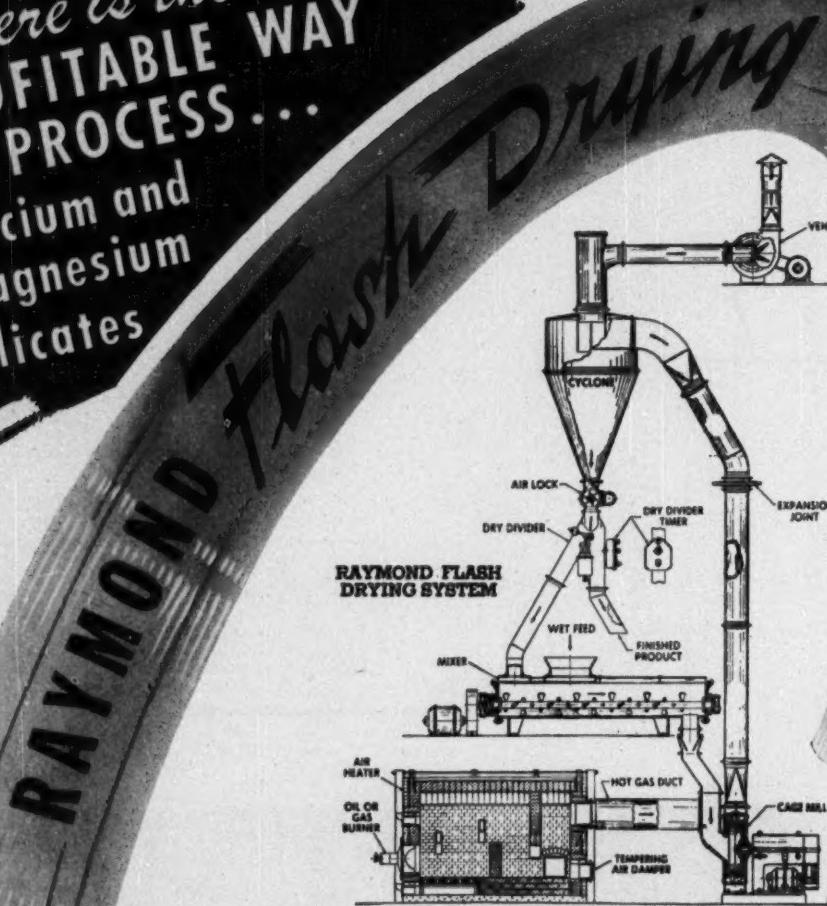


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Calcium Silicate and Magnesium Silicate are typical of a group of products which can be handled by the Raymond Flash Drying System at a big saving in cost, and with close control over quality of product.

The raw material usually comes in the form of filter cake, containing about 60% to 80% moisture. It is put through a Cage Mill Flash Drying System, where the material is disintegrated to its original particle size, and the moisture reduced to a fraction of one per cent.

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This is a clean, dustless, automatic system, combined in a single unit of equipment. It eliminates separate dryers and conveyors. It is flexible in arrangement, and easily installed to fit your plant layout. Its proven economies assure better profits through lower costs per ton of production.

If you have a drying-pulverizing problem, write for Raymond Catalog No. 54-A which describes applications for Flash Drying.

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## GUIDED TOUR CONTINUED

### YOU AND YOUR JOB

How good a technical witness would you be?..... 282

Have you ever

been in a courtroom?

What to do if and when  
you are on the stand as an  
expert witness. How to an-  
ticipate lawyers' shenanigans.  
*(You and Your Job)*.

### CORROSION FORUM

An introduction to the stainless steels..... 290

Corrosion resistance of fused quartz..... 302

### NAMES IN THE NEWS

"Murph" Murphree to get IRI Medal..... 308

The wheresores

of stainless steels.

Here's an introduction to a  
series of charts on corrosion  
resistances of the more than 30  
types (*Corrosion Forum*).

### INDUSTRIAL NOTES

Who's doing what among your suppliers..... 322

### QUOTES, EXTRACTS AND DIGESTS

Common-sense corrosion control..... 332

### CHEMICAL ENGINEER'S BOOKSHELF

Surface films and imperfect crystals..... 356

Your checklist of recent books & pamphlets..... 358

New literature from the manufacturers..... 362

### CHEMICAL ECONOMICS

Plastics on the move..... 370

Big decline in inventories centers in chemicals... 372

Valveless control

for loose solids.

Here's a simple way to feed  
loose solids into a gas lift  
or other pneumatic conveyor  
*(Tomorrow's Technology)*.

### TOMORROW'S TECHNOLOGY

New feeder for loose solids..... 374

Stronger gypsum plaster..... 380

Your checklist of new patents..... 390

AND—Advertisers' Index pre-

ceeds your Reader Service  
section inside the back cover.

### READER SERVICE

Chemicals, equipment, services..... 477



## How Good a Technical Witness Are You?

Each year thousands of cases require expert engineering testimony. A skilled attorney tells how to keep a cross-examiner from making a monkey out of you.

### C. M. HUDSPETH

To most engineers the inside of a courtroom is something remembered from the movies or from the time they ante-dup two dollars for overtime parking. Yet the number of court cases requiring the opinion of engineering experts run into the thousands each year. And one of these days you may be called to answer questions like these: What caused the explosion of

the tank of gasoline? What are its physical and chemical properties and how far will its fumes carry under given conditions? Is it possible that friction caused by the liquid itself could have ignited it? When the stucco fell from the building (injuring a passerby) did it fall because the builder used a cheaper stucco composition than the building code required? Is the odor control problem in a given community due to carelessness on the part of a chemical processor or is it a situation beyond the processor's control? Did the soft drink bottle explode

C. M. HUDSPETH is an Attorney at Law with the firm of De Lange and Hudspeth of Houston, Texas. He is also a lecturer at the Rice Institute.

because of an imperfection in the glass or through mishandling by the victim? Is the novel device discovered by the engineer patentable? Is it in fact novel? Does it have utility? Is it an invention?

Answering questions like these in his field of specialty is relatively easy for the engineer. But answering them in terms that a judge and jury can understand is often not so easy.

### Before the Trial

The trick for the engineering witness is to anticipate some of the problems and pitfalls and to be prepared for them. Here are some tips on courtroom psychology.

► **Do Some Ground Work**—Get together with your trial lawyer. He'll help you pitch the technical problem

in  
out

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## YOU AND YOUR JOB, cont. . .

on a level that he, and later a jury, can understand.

► **Talk Plain**—Forget highly technical phraseology and jargon. Talk in words of one syllable. You may consider such oversimplification an affront to the science and profession, but it will be virtually necessary to win your case.

► **Keep Alert**—Bear in mind that the cross-examiner, in an attempt to discredit you, the expert witness, will try everything at his command to impeach your statements or to lead you into new valleys where you will either be unprepared or uninformed. So be sure to anticipate within reasonable bounds any questions and answers lying on the periphery of the immediate problem.

The extent of pretrial work the engineer may be called upon to perform is almost without limit, but here are some of the more common things the engineer can do to help the attorney.

- Collect evidence on the ground. Get any necessary photographs, maps, models, etc. Interview witnesses.

- Conduct technical investigations. After such an investigation, the engineer might advise the lawyer that the case is technically hopeless. Knowing this before the trial could put the lawyer in a better bargaining position.

- Prepare exhibits to scale.

- As technical counsellor, the engineer can review any evidence, perhaps suggesting other expert witnesses.

## During The Trial

So much for the engineer before he reaches the courtroom; inside his conduct and behavior on the witness stand will become of paramount importance. The lawyer first must qualify him as an expert, which is usually no arduous task, for that term, as so used, does not necessarily connote years of college training, but any one, from a wood-chopper to the most learned pure scientist, who can show that by virtue of his training and experience he has acquired special knowledge on the problem at hand. If the expert can boast a number of college degrees and years of special training, this will, of course, be used to qualify him, together with mention of such professional licenses as he may have, and outstanding papers or treatises that he may have written.

► **The Expert's Prerogative**—It is important that the witness be classed as "an expert" for the law allows ex-

perts to express opinions, whereas lay witnesses are confined to relating the facts.

A moment's reflection will lead you to ask what the difference is, and I, as indeed all lawyers, would be hard-put to explain the difference because it is not categorical but one of degree. For example, the lay witness could testify that the fence was six feet high, but without showing some special knowledge, probably could not testify that the fence was high enough to be deer-proof. If he were a deer expert, his opinion testimony to this effect would be permitted. The epistemologist might ask if we really "know" anything, or whether all is mere opinion; the law, however, is more practical in its rules of evidence.

Since the expert witness may give expert opinion, he may be asked hypothetical questions, and may be allowed to assume the existence of certain facts in order that he may state his conclusions based upon assumptions. The attorney will have to exercise care to see that the hypothetical facts asked either conform or bear a very close relation to the facts in his own particular case.

► **Don't Show-Off**—On the witness stand, the engineer should remain courteous and collected, and while he should avoid the appearance of knowing too much, or being overbearing, the average jury probably would not be favorably impressed with the expert if he overdoes the common touch. No golden rule for most effective presentation exists, largely because of the inexactitude of all rules dealing with man (and especially twelve men); in a word, the best behavior will be "professional"—showing zeal for the correctness of your scientific conclusions, but otherwise less partisanship than will be shown by the average lay witness.

► **Don't Become Angry**—One of the more common failings of the expert witness is to become angry when subjected to cross-examination. A display of temper will do more to destroy the effectiveness of his testimony than most anything that he can do. If opposing counsel tries to badger him, or cast aspersions on his professional qualifications, or his conclusions, it may be extremely difficult to retain composure. It is, however, a necessity.

► **Stick to the Truth**—Several further remarks concerning conduct on cross-examination should be made. Often-times opposing counsel will ask if you



Typical pipes and fittings of nonplasticized polyvinyl chlorides fabricated to specifications by Van Dorn.

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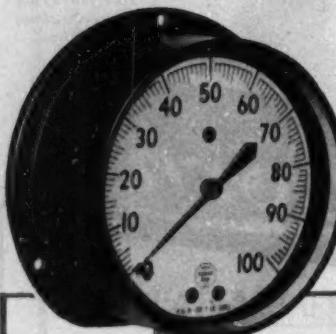
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## HELICOID Chemical Gage

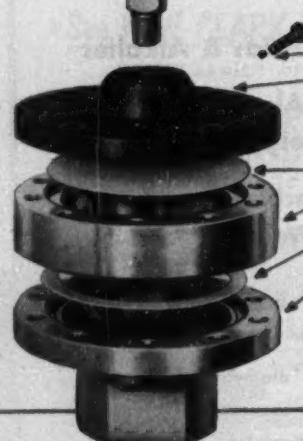
*The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year*



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### YOU AND YOUR JOB, cont. . .

have conferred at length with your lawyer.

For some unknown reason witnesses often feel that they have been guilty of a conspiracy if they admit that they have, and will make the preposterous and untrue statement that they have not so conferred. Obviously the correct answer is the true one, and if asked if you have conferred at length with your attorney, it probably will lend emphasis to the correctness of your conclusions if you state the full extent that your consultations have gone.

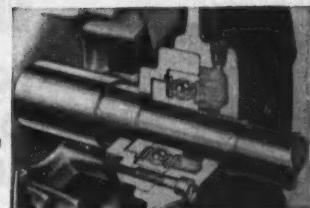
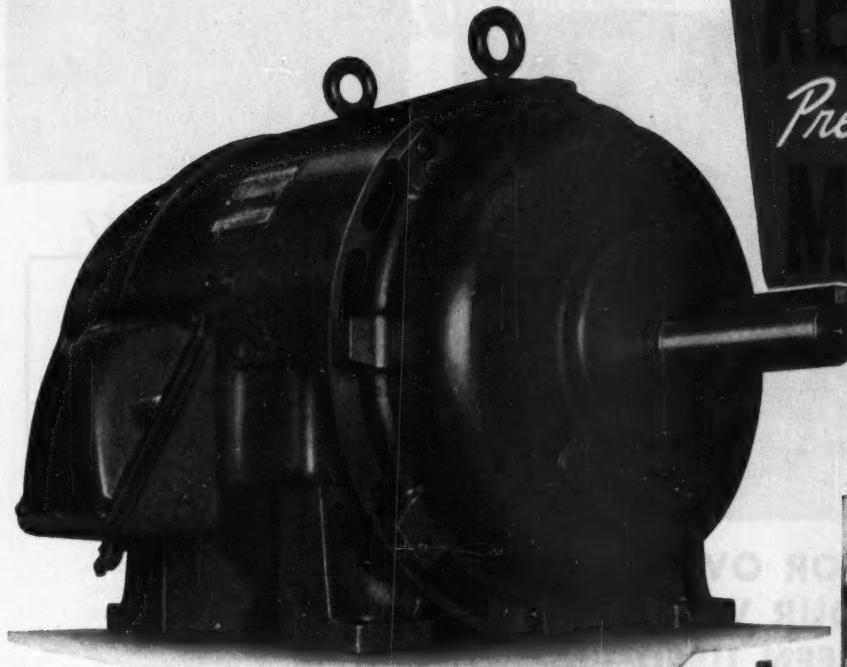
Again, cross-examiners take a delight in asking questions that you cannot answer. Some have even been known to ask if the witness is familiar with a treatise that is non-existent. Do not hesitate to admit that you do not know the answer to a question, and perhaps that you are unwilling to speculate. You may then ask for opportunity to explain that you could find the answer with time and study, or perhaps your counsel will ask and you can show why such question is completely irrelevant to the matter at hand.

A frank admission of ignorance on specific questions oftentimes is as convincing as an answer. And again, the cross-examiner may lead you by asking questions that suggest a ready-cut answer. Your own lawyer will not enjoy this privilege on direct examination.

The main warning is: Do not be misled. If the question is of the "do you still beat your wife" type, don't attempt a yes or no reply, but take the time, as the court will give you, to give a full explanation.

► **Have an Agreement**—Naturally you will be interested in knowing whether the expert is entitled to a fee for serving as a witness. Of course, when you are called upon for pre-trial consultation and courtroom appearance by a friendly attorney, you can usually assume that he expects to pay. It is proper, and even preferable, however, that you have an understanding on this subject before your work begins. The amount of your fee will be for your determination, but in all likelihood will be based upon several factors, such as the time consumed, the amount involved, perhaps the outcome of the litigation, and the degree of specialized skill required to qualify you as an expert witness.

# DEPENDABLE...because they're ENGINEERED FOR CHEMICAL SERVICE



*Reliance Totally-enclosed Fan-cooled A-c. Motor.  
All other standard enclosures available, with  
wide choice of mechanical designs and special  
mountings. Ratings from  $\frac{1}{4}$  to 300 hp.*

Rugged Reliance A-c. Motors are proving that "All Motors Are NOT Alike" on critical jobs throughout the chemical industry. Heavy shafts, bearing to bearing—indestructible pressure-cast aluminum rotors—shock-resistant frame and bearing-bracket construction—man-sized conduit boxes—pressure-welded core laminations—and tough Reli-X insulation are among the many features that make these motors the most dependable, most economical that you can buy.

To see for yourself why these better motors will perform better on *your* job, call an Application Engineer at the Reliance Sales Office nearest you.

B-1454

## WHY THE RELIANCE PRE-LUBRICATED BEARING DESIGN IS BEST

The Reliance pre-lubricated bearing provides *four times more operating hours without re-lubrication* than any other bearing used in motors today. And — whatever your lubrication schedule — *you just can't grease 'em wrong!* To get the complete "inside story" on motor bearings, write today for Bulletin B-2201. It contains hard facts on the advantages of the Reliance pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers.

# RELIANCE ELECTRIC AND ENGINEERING CO.

1063 Monroe Road, Cleveland 10, Ohio • Branches and Distributors in Principal Cities

# Whatever Your Kettle Need— **BETHLEHEM** Can Meet It

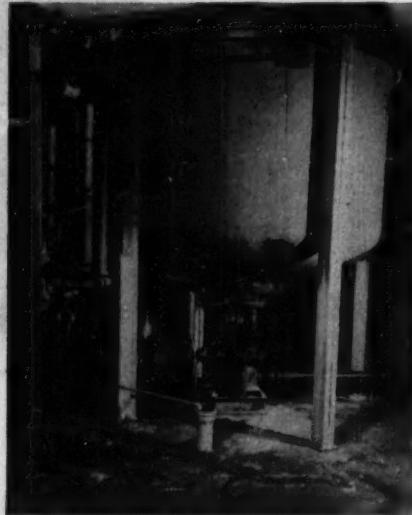
Our competent experienced engineering staff and well-equipped foundry and shops can effectively translate your processing vessels need into efficient, durable equipment.

TYPICAL  
BETHLEHEM  
VESSELS

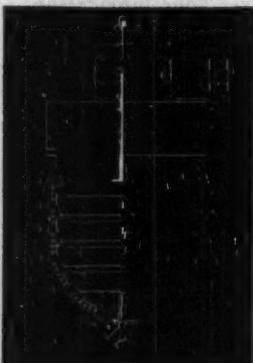


**REDUCER**

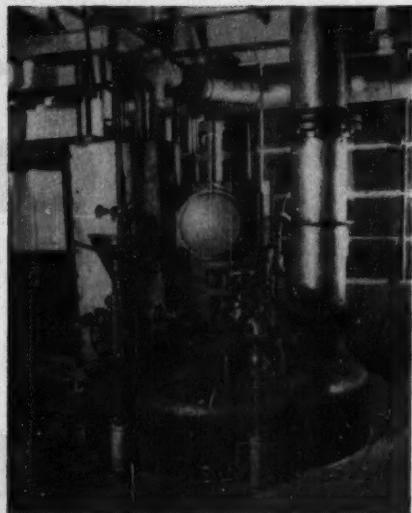
Cast-iron kettle and cover; fabricated-steel jacket.



**REACTOR**  
Stainless-clad construction.



**GREASE KETTLE**  
THERMOCOIL (Steel coil integral with cast-iron wall).



## STAINLESS CLAD KETTLE

### FOR OVER FORTY YEARS OUR VESSELS HAVE BEEN USED—for

- **CORROSIVE SERVICE** such as sulfonations, nitrations, reductions.
- **DIRECT FIRED OPERATIONS** such as caustic fusions, sodium bisulfate and carbon disulfide manufacture.
- **HEAVY DUTY NEEDS** such as processing extremely viscous and pasty materials.
- **HANDLING ABRASIVE SOLIDS**, especially in reaction.

Bethlehem manufactures vessels in **cast metals and fabricated steel, stainless steels, alloys, and clad**; to ASME Code, other specifications, and company standards. X-ray and other test techniques assure sound construction for demanding service.

You will find it profitable to learn more about Bethlehem processing vessels for reaction, agitation, heat transfer, distillation, sublimation, crystallization, drying.

Write today for 8-page, 2-color folder  
illustrating and describing our line of fabricated and cast kettles.

**BETHLEHEM FOUNDRY & MACHINE CO.**  
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# Choose Your Gas Mover from this Wide Range!

## ALLIS-CHALMERS OFFERS 5 TYPES FOR CHEMICAL PROCESSES

WHETHER YOUR PROCESS calls for aeration, agitation, circulation, or combustion . . . Allis-Chalmers can meet your particular need from its wide range of air and gas moving equipment.

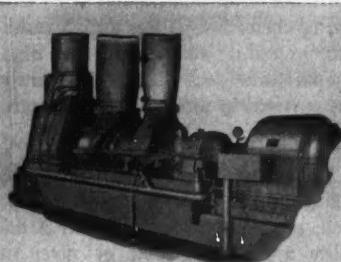
A-C will design to your exact job requirement and will build standard or special, as required. Each of the five types shown can be supplied specifically engineered for corrosive gases . . . for close control of pressure and volume . . . for automatic or manual operation and other variable factors.

*Manufacturer experience?* Allis-Chalmers has been building air and gas moving equipment and their drives for over half a century. *One-manufacturer responsibility?* All the equipment shown on this page is Allis-Chalmers designed and built!

Put this ability to work for you! A-C will build you a completely integrated installation: blower, compressor or pump . . . electric motor or gas or steam turbine drive . . . manual or automatic flow or pressure control. For detailed information or literature on these products, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

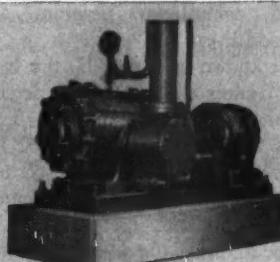
A-3876

## ALLIS-CHALMERS



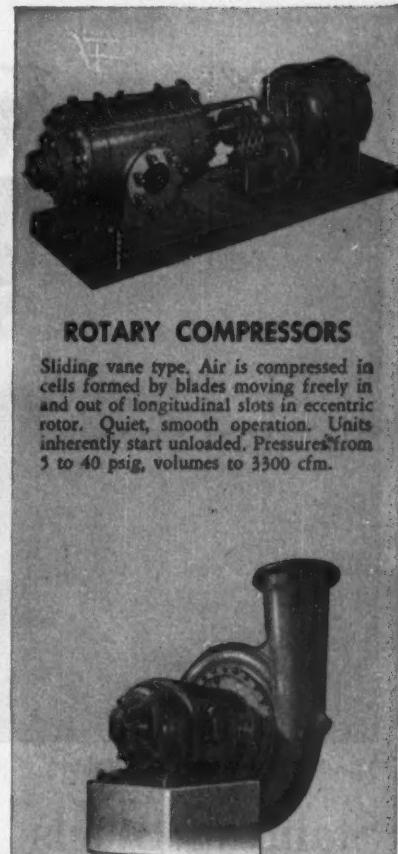
### AXIAL COMPRESSORS

Used in catalytic refining. Handle large fixed volumes of air with pressure variations over a wide range. Good base load machines. Able to compress to 50 lb G with high efficiencies. Units in service to 870,000 cfm.



### DRY VACUUM PUMPS

Same principle as rotary compressors except applied to evacuation. Sliding vane type with no internal valves. Saves floor space. Built in capacities ranging from 10 to 28 in. Hg, 55 to 5750 cfm, 3 to 250 hp.



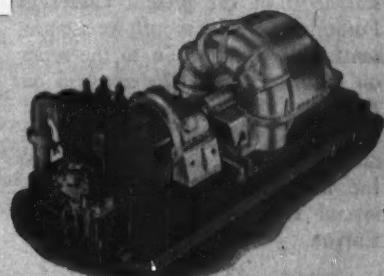
### ROTARY COMPRESSORS

Sliding vane type. Air is compressed in cells formed by blades moving freely in and out of longitudinal slots in eccentric rotor. Quiet, smooth operation. Units inherently start unloaded. Pressures from 5 to 40 psig, volumes to 3300 cfm.



### SINGLE STAGE BLOWERS

Often used for agitation and aeration in fermentation. Discharge nozzle can be arranged in any of 24 positions. Cast casing provides rigid, smooth operation. Available in pressure ranges from 1 to 6.50 lb, volumes to 35,000 cfm.

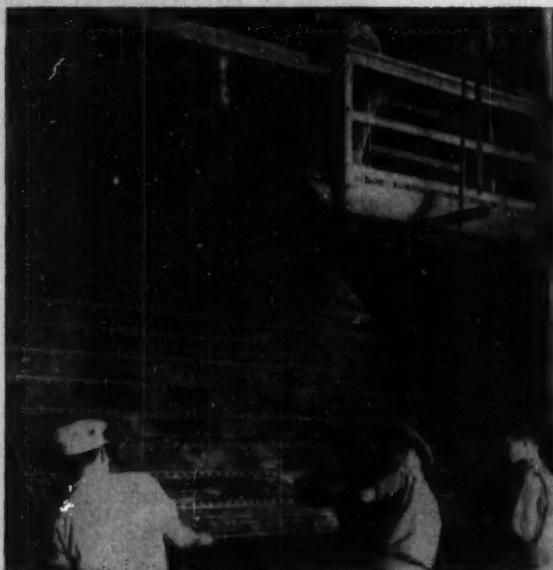


### MULTI-STAGE BLOWERS

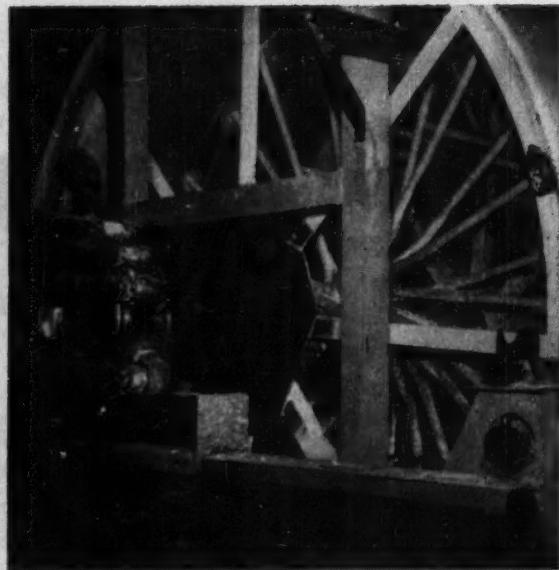
Centrifugal type, for boosting, exhausting, circulating. Cannot build up dangerous pressures. Have enclosed backward-bladed impeller wheels. Pressure volume curve favorable to parallel operation. Capacities to 130,000 cfm.

# The Corrosion Forum

Edited by Morgan M. Hoover



Type 310 stainless steel dryer flights.



All-stainless steel vacuum type filter.

## **Stainless Steels**

**The important factors to watch in the selection of any stainless steel, regardless of grade, such as operating conditions, design and fabrication requirements.**

### **COMMITTEE OF STAINLESS STEEL PRODUCERS**

**American Iron & Steel Institute**

**NOTE:** Chart data of corrosion resistance for various grades of stainless steels will appear in the next four installments of the present Corrosion Forum series. This month we are presenting an introduction to the series on stainless steels, with emphasis on those factors which apply to all the common types. Then, starting next month, we will take up the 18-8 grades, the molybdenum-bearing grades, and several straight chromium grades—**EDITOR.**

**Stainless steels** (high chromium and chromium-nickel alloys of iron) occupy an important place in processing equipment used by chemical and allied industries. They are durable, heat and corrosion resistant, non-contaminating. They are also easily fashioned and maintained.

There are more than 30 standard

types of stainless steel, and many special alloys. They all contain at least 12 percent chromium, often 7 percent or more nickel, sometimes molybdenum, columbium, titanium, and other additives.

Best known is Type 302, the basic 18-8 stainless with about 18 percent chromium and 8 percent nickel. Type 304 is very much like Type 302 but has lower limits on carbon content and contains a higher mean chromium and nickel content.

Type 316 is of the same family with added molybdenum. This element increases corrosion resistance and high temperature strength. It suits stainless for many chemical tasks that it could not otherwise perform.

Type 410 contains 12 percent chromium. It is a hardenable, heat-resistant alloy with good machining properties. One of the most widely used of the

hardenable types of corrosion resistant steels, Type 410 is capable of attaining high mechanical properties when heat-treated.

Type 430, nominally a 17 percent chromium stainless, may contain anywhere from 14 to 18 percent of this one alloying element. Lack of added nickel imposes penalties such as reduced ductility, low-temperature brittleness, and slightly less resistance to pit-type corrosion than type 302 under some conditions. Nevertheless, Type 430 is an extremely useful material. It is important because of its excellent resistance to nitric acid and other oxidizing chemicals. It has a high resistance to scaling and oxidation at high temperatures such as are frequently encountered in industrial applications.

### **WATCH SHIFT IN GALVANIC SERIES**

In corrosive environments of an oxidizing nature where they do their jobs well, the stainless steels display a nobility approaching that of silver or platinum. But when placed in strongly reducing media and deprived of oxygen, these alloys may shift up the galvanic series to a vulnerable position near carbon steel. Though the relationship of galvanic potential in a particular solution to corrosion resistance under other conditions will not necessarily remain constant, the fact

# HASTELLOY

Trade-Mark

## Alloy X

*A New*

### "HAYNES" HIGH-TEMPERATURE ALLOY

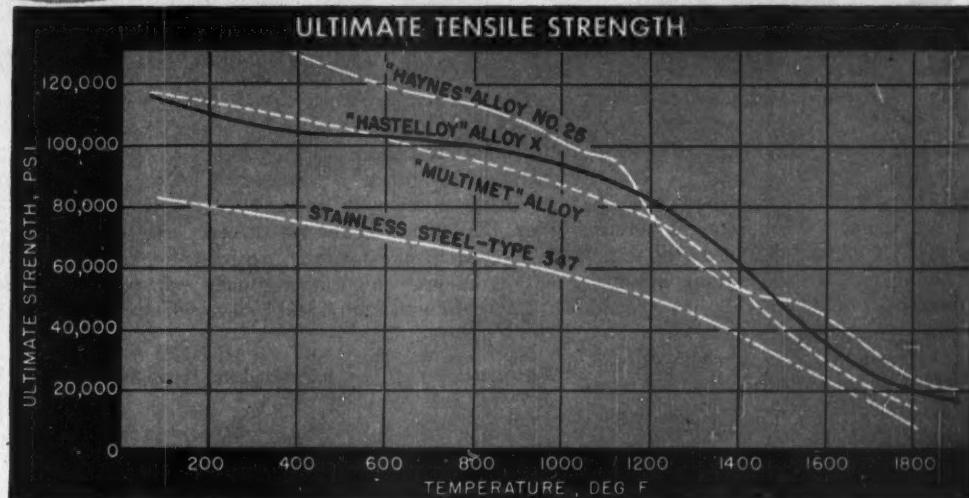
High Strength at Elevated Temperatures

Excellent Oxidation Resistance

Low Strategic Alloy Content

Excellent Formability

Good Casting Characteristics



The excellent high-temperature properties of HASTELLOY alloy X—a new material that contains iron, nickel, chromium, and molybdenum—make this alloy a good choice for aircraft sheet-metal parts, such as cabin heaters, tail cones, and collector rings. It is also being tested for aircraft nozzle vanes, both precision-investment-cast and fabricated from sheet. In addition, it is designed for high-temperature applications in the chemical, petroleum, metal-producing, and heat-treating industries.

HASTELLOY alloy X has a relatively low content of strategic metals. Tests made so far indicate that alloy X has high-temperature properties comparable to those of other alloys containing a higher percentage of strategic metals (see graph).

The new alloy is available as sheet, plate, bars, wire, and precision-investment castings. For additional properties data, write to our General Offices in Kokomo, Indiana, for a copy of the new booklet "HASTELLOY Alloy X."

# HAYNES

TRADE-MARK

## Alloys

"Haynes," "Hastelloy," and "Multimet" are trade-marks of Union Carbide and Carbon Corporation.

### Haynes Stellite Company

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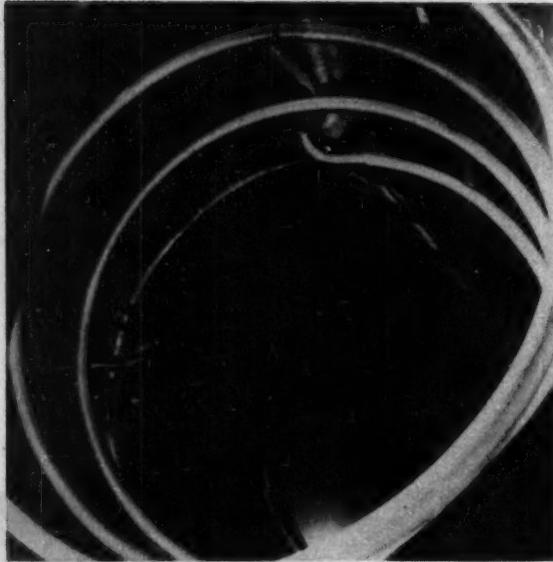


General Offices and Works, Kokomo, Indiana

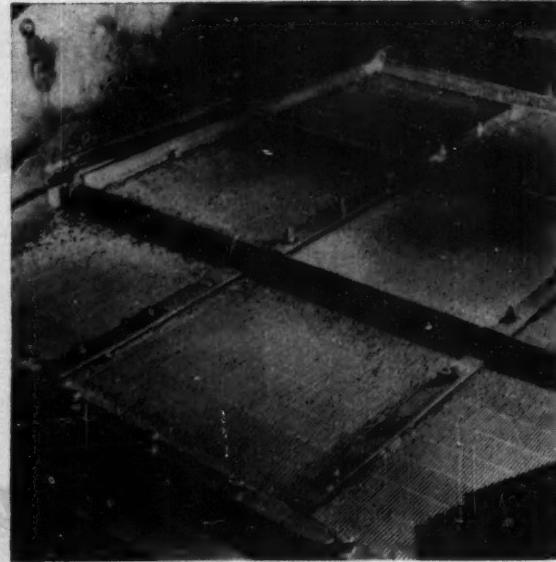
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Type 304 stainless steel mixing tank.



Stainless steel dewatering and sizing screens.

that a change can take place is worth noting.

This remarkable phenomenon affects uses and applications in several ways. It imposes a limit on the scope of application, for one thing. Strongly reducing solutions—the acid halide salts especially—are a signal for caution in applying stainless. Designing equipment without crevices has proved most desirable. Caked deposits, stagnation, differential aeration, or situations involving differentials in concentrations can result in formation of oxidation-reduction cells and localized pit-type corrosion.

#### **Stainless Steel in the Galvanic Series (In Sea Water)**

(Anodic end at top, cathodic at bottom)

Magnesium

Magnesium alloys

Zinc

Aluminum (2%)

Cadmium

Aluminum (17%)

Mild steel

Wrought iron

Cast iron

Ni-Resist

13% chromium stainless (Type 410)

18-8 chromium-nickel stainless (Type 304) Active

18-8, 3% molybdenum stainless (Type 316)

Lead

Tin

Nickel (active)

Inconel (active)

Brasses

Copper

Copper-nickel alloys

Nickel (passive)

Inconel (passive)

Mn

13% chromium stainless (Type 410)

18-8 chromium-nickel stainless (Type 304) Passive

18-8, 3% molybdenum stainless (Type 316)

Silver

Graphite

Gold

Platinum

Adapted from Table 18, p. 416, *Corrosion Handbook*  
Uhlig, H., John Wiley & Sons, 1948

Stainless steel resists corrosion best when all its surface is oxidized to the noble position in the galvanic series. This occurs in the air. It can be speeded by the familiar "passivation" technique—an operation usually accomplished with a nitric acid bath or

swabbing followed by a fresh water rinse. Nitric acid also provides a chemical cleaning and removes any stray iron which might become a focal point for localized attack. How permanent the passivity will be depends on what happens to the stainless steel in service.

#### **AISI Standard and Tentative Standard Types—Stainless and Heat-Resisting Steels—Chemical Ranges and Limits**

Type Number	C	Mn Max.	Si Max.	Cr	Ni	Other Elements
301	Over 0.08/0.20	2.00	1.00	16.00/18.00	6.00/8.00	_____
302	Over 0.08/0.20	2.00	1.00	17.00/19.00	8.00/10.00	_____
302B	Over 0.08/0.20	2.00	2.00/3.00	17.00/19.00	8.00/10.00	_____
303	0.15 max.	2.00	1.00	17.00/19.00	8.00/10.00	_____
304	0.08 max.	2.00	1.00	18.00/20.00	8.00/11.00	_____
304L	0.03 max.	2.00	1.00	18.00/20.00	8.00/11.00	_____
305	0.12 max.	2.00	1.00	17.00/19.00	10.00/13.00	_____
308	0.08 max.	2.00	1.00	19.00/21.00	10.00/12.00	_____
309	0.20 max.	2.00	1.00	22.00/24.00	12.00/15.00	_____
309S	0.08 max.	2.00	1.00	22.00/24.00	12.00/15.00	_____
310	0.25 max.	2.00	1.50	24.00/26.00	19.00/22.00	_____
310S	0.08 max.	2.00	1.50	24.00/26.00	19.00/22.00	_____
314	0.25 max.	2.00	2.00/3.00	23.00/26.00	19.00/22.00	_____
316	0.10 max.	2.00	1.00	16.00/18.00	10.00/14.00	Mo 2.00/3.00
TS 316	0.10 max.	2.00	1.00	16.00/18.00	10.00/14.00	Mo 1.75/2.50
316L	0.03 max.	2.00	1.00	16.00/18.00	10.00/14.00	Mo 1.75/2.50
317	0.10 max.	2.00	1.00	18.00/20.00	11.00/14.00	Mo 3.00/4.00
321	0.08 max.	2.00	1.00	17.00/19.00	8.00/11.00	Ti 5xC min.
347	0.08 max.	2.00	1.00	17.00/19.00	9.00/12.00	Cb 10xC min.
TS 347	0.08 max.	2.00	1.00	17.00/19.00	9.00/12.00	Cb 8xG min.
TS 347A	0.08 max.	2.00	1.00	17.00/19.00	9.00/12.00	Cb-Ta 8xG min.
403	0.18 max.	1.00	0.50	11.50/13.00	_____	Al 0.10/0.30
405	0.08 max.	1.00	1.00	11.50/13.50	_____	_____
410	0.15 max.	1.00	1.00	11.50/13.50	_____	_____
414	0.15 max.	1.00	1.00	11.50/13.50	1.25/2.50	_____
416	0.15 max.	1.25	1.00	12.00/14.00	_____	Note 3
420	Over 0.15	1.00	1.00	12.00/14.00	_____	_____
430	0.12 max.	1.00	1.00	14.00/18.00	_____	_____
430F	0.12 max.	1.25	1.00	14.00/18.00	_____	_____
431	0.20 max.	1.00	1.00	15.00/17.00	1.25/2.50	Note 3
440A	0.60/0.75	1.00	1.00	16.00/18.00	_____	Mo 0.75 max.
440B	0.75/0.95	1.00	1.00	16.00/18.00	_____	Mo 0.75 max.
440C	0.95/1.20	1.00	1.00	16.00/18.00	_____	Mo 0.75 max.
446	0.35 max.	1.50	1.00	23.00/27.00	_____	N 0.25 max.

Note 1. TS 316, TS 347 and TS 347A are tentative standard type numbers; the remainder of the type numbers are standard type numbers.

Note 2. The maximum phosphorus content of the "300" series of type numbers, except type number 303 is 0.045 percent. The maximum phosphorus content of the "400" series, except type numbers 416 and 430F, is 0.04 percent. The maximum sulfur content for all type numbers, except 303, 416, and 430F, is 0.030 percent.

Note 3. Phosphorus or sulfur or selenium, 0.07 percent minimum; silicon or molybdenum, 0.60 percent maximum.

Note 4. The maximum content of molybdenum of 2.50 percent in 316L and TS 316 is established in accordance with National Production Authority Order M-52, March 31, 1951.

Note 5. The minimum ratio of columbium to carbon in TS 347 of not greater than 8 to 1 and the minimum ratio of columbium-tantalum to carbon in TS 347A of not greater than 8 to 1 are established in accordance with National Production Authority Order M-3 as a modified March 15, 1951.

## **How much better will Durcopumps do your pumping job?**

The Series R Durcopumps are engineered and built for heavy duty pumping with less maintenance. They're available as standard items in 12 alloys from our own foundry.

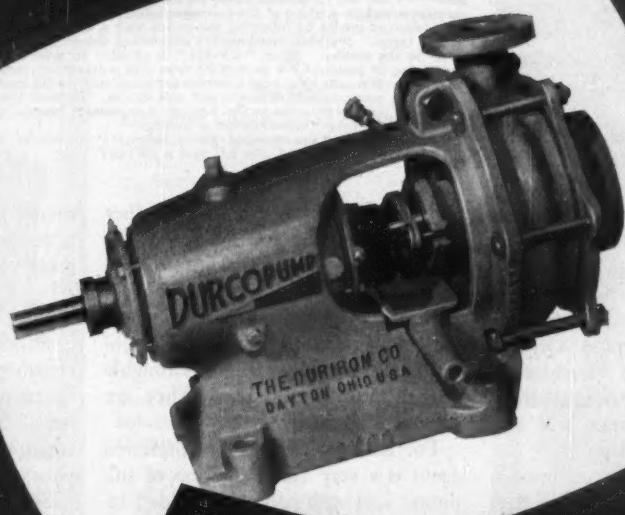
In many plants they're considered "standard equipment." *How much better* will they handle the corrosive you use?

Why not let us send you Durcopump Bulletin P/1? It will give you complete construction details and performance information to help you decide.

A DURCO representative near you will be happy to help you select the right pump in the right alloy.

WRITE OR PHONE FOR YOUR FREE COPY OF BULLETIN  
P/1

Series R Durcopumps



Duriron, Durichlor,  
Durimet 20, Durco D-10M,  
Chlorimet 2, Chlorimet 3, Monel, Nickel,  
Inconel, Ni-Resist #2, 18-8-S-Mo, Cast Steel and Cast Iron

The Duriron Company, Inc.  
Dayton, Ohio



- 1
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- 5
- 6

## SURFACES MUST BE CLEAN

As a rule the purpose of routine cleaning is to remove surface deposits rather than any corrosion products of the metal itself. This allows oxygen to get at the surface to keep the alloy in the passive state. At the same time, it reduces the chance of attack from differential aeration, formation of oxidation-reduction cells.

Frequency of cleaning depends on the rate at which the equipment gets dirty. It is a function of the process and the materials involved—not a predictable thing which can be related to the behavior of the metal.

In general, tightly adhering deposits of "baked-on" splatter, oil, grease, dyes or other light discolorations may be removed with any mild cleanser and gentle rubbing with a damp cloth. One of the common household cleansers may be used or Grade FFF Italian Pumice or whiting. Heavy discoloration or heat tint may be removed by using stainless steel wool in place of the damp cloth. A warm 5 percent oxalic acid solution or a 5-15 percent nitric acid solution may also be used for removing heat tint. The equipment must be swabbed or immersed and followed with a 5 percent sodium carbonate or neutralizer rinse.

Such materials as grease, oil, fatty acids can be removed by a 4-6 percent solution of sodium metasilicate, trisodium phosphate, sodium metaphosphate, or sodium pyrophosphate. A 5-15 percent solution of caustic soda can be used for this purpose. Organic solvents such as carbon tetrachloride, naphtha, acetone, kerosene, gasoline, ether, alcohol, or benzene will also remove oil and grease deposits.

Ordinary steel wool or steel brushes should never be used on stainless steel surfaces. Particles of steel may become imbedded in the stainless steel surface, and rusting of these particles will eventually appear as stains. Use stainless steel wool or sponge on stainless steel equipment.

Heat tint removers will usually scratch stainless steel surfaces. This, however, is necessary in removing heat tint by abrasion. Chemical preparations that remove heat tint are available.

Heat exchangers pose special problems. Deposits on the water or steam side of the exchanger are mineral in nature, largely insoluble in water, and relatively inaccessible in many cases.

## ACI Standard Designations and Chemical Composition Ranges for Heat and Corrosion Resistant Castings

Cast Alloy Designation	Wrought Alloy Type (See Note A)	Composition, Percent								
		C	Mn Max.	Si Max.	P Max.	S Max.	Cr	Ni	Other Elements	
CA-15	410	0.15 max.	1.00	1.50	0.04	0.04	11.5-14	1 max.	Mo 0.5 max. <sup>†</sup>	
CA-40	420	0.20-0.40	1.00	1.50	0.04	0.04	11.5-14	1 max.	Mo 0.5 max. <sup>†</sup>	
CB-30	431	0.30 max.	1.00	1.00	0.04	0.04	18-22	2 max.		
CC-50	446	0.50 max.	1.00	1.00	0.04	0.04	26-30	4 max.		
CE-30	—	0.30 max.	1.50	2.00	0.04	0.04	26-30	8-11		
CF-8	304	0.08 max.	1.50	2.00	0.04	0.04	18-21	8-11		
CF-20	302	0.20 max.	1.50	2.00	0.04	0.04	18-21	8-11		
CF-5M	316	0.08 max.	1.50	1.50	0.04	0.04	18-21	9-12	Mo 2.0-3.0	
CF-12M	316	0.12 max.	1.50	1.50	0.04	0.04	18-21	9-12	Mo 2.0-3.0	
CF-8C	347	0.08 max.	1.50	2.00	0.04	0.04	18-21	9-12	Cr 8xC min., 1.0 max., or Cr-Ta 10xC min., 1.35 max <sup>‡</sup>	
CF-16F	303	0.16 max.	1.50	2.00	0.17	0.04	18-21	9-12	Mo 1.5 max., Se 0.20-0.35	
CF-16Fa	303	0.16 max.	1.50	2.00	0.04	0.20-0.40	18-21	9-12	Mo 0.40-0.80	
CH-20	309	0.20 max.	1.50	2.00	0.04	0.04	22-26	12-15		
CK-20	310	0.20 max.	1.50	2.00	0.04	0.04	22-27	10-22		
CK-7MCu	—	0.07 max.	1.50	*	0.04	0.04	18-22	21-31	Mo-Cu*	
HC	446	0.80 max.	1.00	2.00	0.04	0.04	26-30	4 max.	Mo 0.5 max. <sup>†</sup>	
HD	327	0.50 max.	1.00	2.00	0.04	0.04	26-30	4-7	Mo 0.5 max. <sup>†</sup>	
HE	—	0.20-0.50	2.00	2.00	0.04	0.04	26-30	8-11	Mo 0.5 max. <sup>†</sup>	
HF	302B	0.20-0.40	2.00	2.00	0.04	0.04	18-23	8-12	Mo 0.5 max. <sup>†</sup>	
HH	309	0.20-0.50	2.00	2.00	0.04	0.04	24-28	11-14	Mo 0.5 max. <sup>†</sup> N 0.2 max.	
HL	—	0.20-0.50	2.00	2.00	0.04	0.04	26-30	14-18	Mo 0.5 max. <sup>†</sup>	
HK	310	0.20-0.60	2.00	3.00	0.04	0.04	24-28	18-22	Mo 0.5 max. <sup>†</sup>	
HL	—	0.20-0.60	2.00	3.00	0.04	0.04	28-32	18-22	Mo 0.5 max. <sup>†</sup>	
HT	330	0.35-0.75	2.00	2.50	0.04	0.04	13-17	33-37	Mo 0.5 max. <sup>†</sup>	
HU	—	0.35-0.75	2.00	2.50	0.04	0.04	17-21	37-41	Mo 0.5 max. <sup>†</sup>	
HW	—	0.35-0.75	2.00	2.50	0.04	0.04	10-14	58-62	Mo 0.5 max. <sup>†</sup>	
HW	—	0.35-0.75	2.00	2.50	0.04	0.04	15-19	64-68	Mo 0.5 max. <sup>†</sup>	

<sup>†</sup> Molybdenum not intentionally added.

<sup>‡</sup> There are several proprietary alloy compositions falling within the stated chromium and nickel ranges and containing varying amounts of silicon, molybdenum and copper. Such alloys are available from licensed producers only.

Designations with the initial letter "C" indicate alloys generally used to resist corrosive attack at temperatures less than 1,200 deg. F. Designations with the initial letter "H" indicate alloys generally used under conditions where the metal temperature is in excess of 1,200 deg. F. The second letter represents the nominal chromium-nickel type; the nickel content increasing in amount from "A" to "X". For example, "F" stands for the 18 percent Cr-9 percent Ni, "K" for the 25 percent Cr-20 percent Ni; "W" for the 12 percent Cr-60 percent Ni alloy types. Numerals following the letters indicate the maximum carbon content of the corrosion resistant alloys; carbon content may also be designated in the heat resistant grades by following the letters with a numeral to indicate the midpoint of a ±0.10 percent carbon range. If special elements are included in the composition they are indicated by the addition of a symbol. Thus, "CF-5M" is an alloy for corrosion resistant service of the molybdenum-containing 10 percent Cr-9 percent Ni type with a maximum carbon content of 0.08 percent.

**NOTE A**—Wrought alloy type numbers are listed only for the convenience of those who want to determine corresponding wrought and cast grades. Because the cast alloy chemical composition ranges are not the same as the wrought composition ranges, buyers should use cast alloy designations for proper identification of castings.

**NOTE B**—Most of the standard grades listed are covered by American Society for Testing Materials specifications A 296-49T and A 297-49T.

Stainless steel withstands the rather severe chemical measures used for cleaning the places that cannot be reached mechanically. Acids are circulated to insure uniform action over a fairly long interval. Following application, these acids must be thoroughly flushed from the system. They are usually not heated.

For most conditions the preferred agent is a very dilute solution of sulfuric acid with a properly added inhibitor (copper sulphate, or any organic inhibitor recommended by a reputable manufacturer). Under careful control of a good organic inhibitor, hydrochloric acid may also be used. Nitric acid solutions are not harmful to stainless steel and may remain in contact as long as required to loosen or remove the objectionable material.

If necessary to use tools in removing scale, special care must be taken to prevent deep scratches or gouges. Such places become centers for corrosive attack. Skillfully-operated mechanical devices or small manually-operated stainless steel tools may be employed. If marring occurs, the metal surfaces

should be refinished before service is restored. Wash with nitric acid after using ordinary steel tools.

## OPERATING CONDITIONS CRITICAL

Of equal importance with regular cleaning habits is the actual control of operating conditions. Marked variations from design conditions may create major maintenance repair or replacement problems.

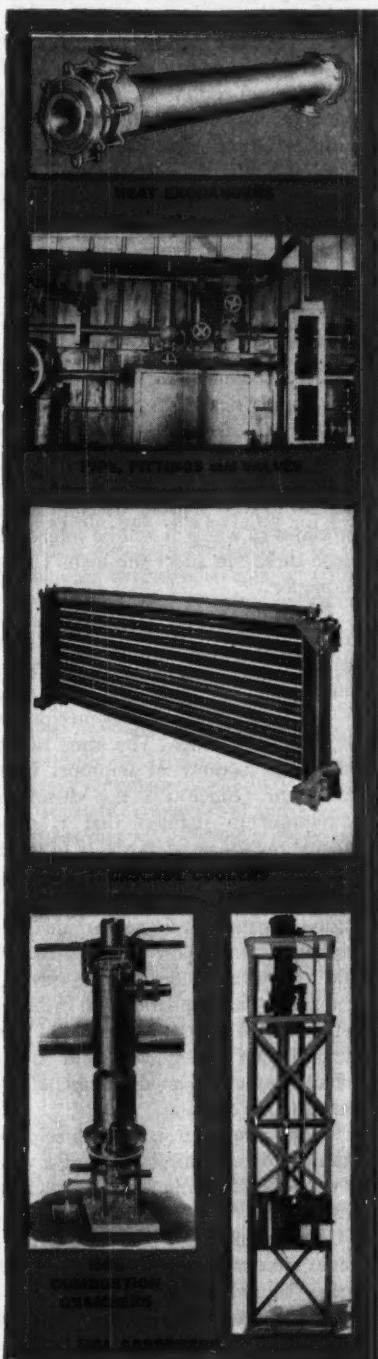
So far as practicable, work for uniform concentrations of process materials. Evaporation can concentrate corrosives in the upper layers of exposed, moist solids, or corrosive vapors may be condensing on vessel-heads, hoods, etc.

Faster processing cycles or agitation can minimize excessive concentration of corrosives that might be caused by gravity, temperature, or other forces.

Processing equipment should be protected against overheating. Unless "stabilized," or unless the carbon content is extremely low, austenitic stainless steels become susceptible to corrosion upon being held between 800 and 1,600 deg. F. for an appreciable

# A CONSTANTLY IMPROVING LINE

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Wide variety of standard and custom-built models in time-proved designs. Shell and tube, concentric and immersion types available in stock sizes. Catalog Sections S-6620, S-6670, S-6740, S-6750.

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The centrifugal pump for handling corrosive fluids. Rugged, trouble-free design. Handling capacities to 800 G.P.M. Catalog Section S-7200.

## PIPE, FITTINGS and VALVES

For industry's toughest fluid conveying requirements. Easy to install and maintain with simple hand tools. Catalog Section S-7000.

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New "Karbate" impervious graphite coolers feature standardized, sectional construction... high heat-transfer rate... low initial cost.

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For heating and agitating corrosive solutions by direct injection of steam. Catalog Section S-7300.

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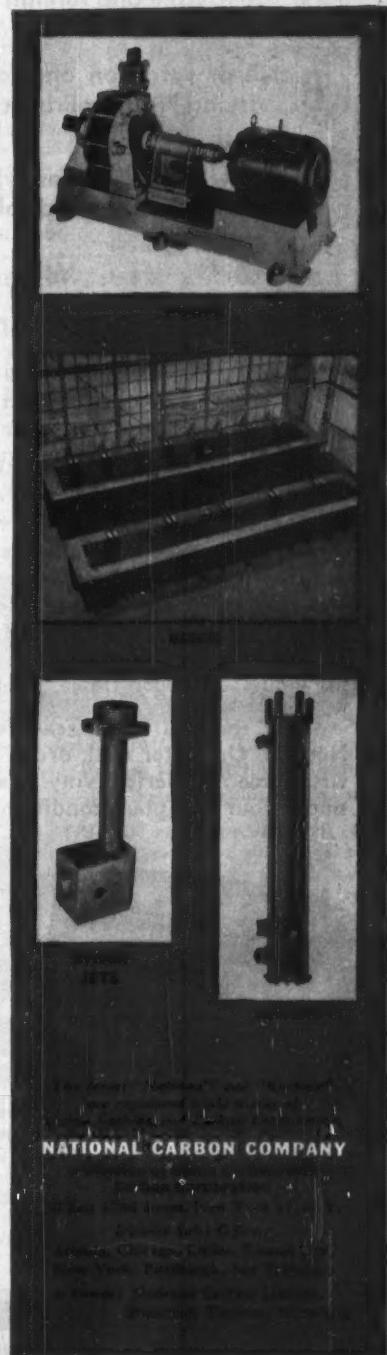
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On old or new metal, this amazing new primer provides positive primer-to-surface and vinyl-to-primer adhesion while also controlling cancerous underfilm corrosion and rust creepage. It's the revolutionary, *simple as A B C* vinyl coating system that licks the toughest corrosion problems while slashing hours off labor time . . . dollars off vinyl painting costs.

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## CORROSION FORUM, cont. . .

time. These alloys also combine a high coefficient of expansion with relatively low thermal conductivity and may therefore be warped or distorted by localized heating. Positive devices such as liquid level gages which prevent such local hot spots may prevent damage to thousands of dollars worth of equipment.

Many chemicals that are only mildly corrosive when pure become difficult to handle if they are mixed or if they contain certain impurities. Contaminated acids and fuels containing sulphur are examples. Possible impurities must therefore be carefully accounted for before a stainless type is decided upon. This is why tests with pure chemicals have only limited applicability in the choice of the proper type of stainless steel.

### FABRICATION AFFECTS RESISTANCE

The maximum corrosion resistance of stainless steels can be attained by proper fabrication techniques. When appraising a given type of stainless for a given piece of equipment it is important to keep in mind the fabrication processes to which it will be subjected since these can affect the metal's performance.

For example whenever the alloy is to be welded or brazed, or kept for some time in its "sensitizing temperature range" (about 800 to 1,600 deg. F.), chromium carbide may precipitate at grain boundaries. The same result can occur because of improper heat treatment. Since it's the dissolved chromium in stainless that is considered the source of its ability to resist corrosive attack, this means that the metal may then display reduced corrosion resistance. Some carbide precipitation can usually be tolerated. If the corrosive conditions are severe, though, grain boundaries with carbides will be attacked first. "Weld decay" or deterioration along welds in heat-affected zones is a good example of intergranular corrosion.

Such chromium carbide precipitation can be minimized by using a very low carbon-containing stainless such as Type 304L ( $C = 0.03$  max.) or 316L ( $C = 0.03$  max.), by proper heat treatment after carbide precipitation, or by using columbium or titanium stabilized stainless steels (Type 321— $Ti = 5 \times C$  min.; or Type 347— $Cb = 10 \times C$  min.).

In the case of Type 430 chromium

stainless, welding temperatures tend to accelerate the formation of brittle martensite at grain boundaries. It can be removed by annealing. The addition of titanium inhibits martensite formation, makes the welds less brittle. Titanium is believed to make welded Type 430 stainless less susceptible to corrosive attack.

Soldered joints on any kind of stainless should have solder with at least 50 percent tin. The action of soldering fluxes should be neutralized immediately with a 5 percent sodium carbonate solution followed by copious water rinsing.

#### DESIGN INFLUENCES PERFORMANCE

It is wise to eliminate from design all places where residue or foreign matter might collect such as crevices and sharp inside corners. Small internal radii should be eliminated, if possible. Inside corners should be filleted, seams kept at a minimum, welds ground smooth.

Faying surfaces of joints between stainless and other metals should be eliminated or insulated. Wood and other porous materials absorb process chemicals and slowly build up high concentrations of corrodents. In the restricted oxygen-poor area of a joint (especially under gaskets), active corrosion can proceed easily.

For example, gaskets or packings containing graphitic materials accelerate such action. Plastics, fiber, or synthetic products containing asbestos should be specified instead. Asphaltum or zinc chromate panes should be used to separate stainless steel and wood.

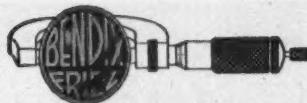
Cleaning will be done more consistently if workmen find it easy to reach all parts of the equipment. To this end, filters, screens, valves, etc. should be easy to get to and remove.

A designer planning actual process equipment should not count on the same kind of behavior in his fabricated metal as observed in sample corrosion tests.

#### MAKE ON-THE-SPOT TESTS

There is grave doubt among corrosion specialists as to the real value of standard corrosion tests in the specification of stainless steels. They note that some stainless steels can always be considered satisfactorily resistant to certain agents. For these alloys and situations there is no problem.

Then there are some reagents to which these alloys are never satisfac-



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.140 x .75	45.0 ohms	86 ohms	194 ohms
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.018 x 1.5	35,000 ohms	82,290 ohms	229,600 ohms

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#### CORROSION FORUM, cont. . .

torily resistant. Again there is no problem.

But for a great many materials, stainless may sometimes be resistant enough for commercial use—at other times not. This middle group contains the interesting cases. Corrosion resistance of stainless is a property of the particular type of stainless, the way it is fabricated, and the environment in which it is being used. A slight change in fabrication or (more often) in the environment can completely invalidate conclusions based on the original test. Or more strictly, the new conditions will bear no significant relationship to those obtaining in the laboratory test.

A practical engineer's problem, then, becomes one of interpretation. How far can the previous tests be used as reliable guides? Must each piece of apparatus be tested for each particular case?

Fortunately, under given corrosive attack there is quite a spread between the least and the most resistant grade of stainless. If the alloy with the greatest corrosion resistance is always specified, the likelihood of successful application is enhanced, of course. But this can be an expensive if not wasteful way of proceeding—especially now when there is a definite shortage of nickel-bearing alloys of all types. Specially-devised, on-the-spot tests can, therefore, be valuable and helpful in choosing.

Tests must be devised to expose joints and shapes of the same kind as those to be used in the actual process. Exposure should be under the same conditions of temperature (heating and cooling) as the final equipment and to the same series of corrodents.

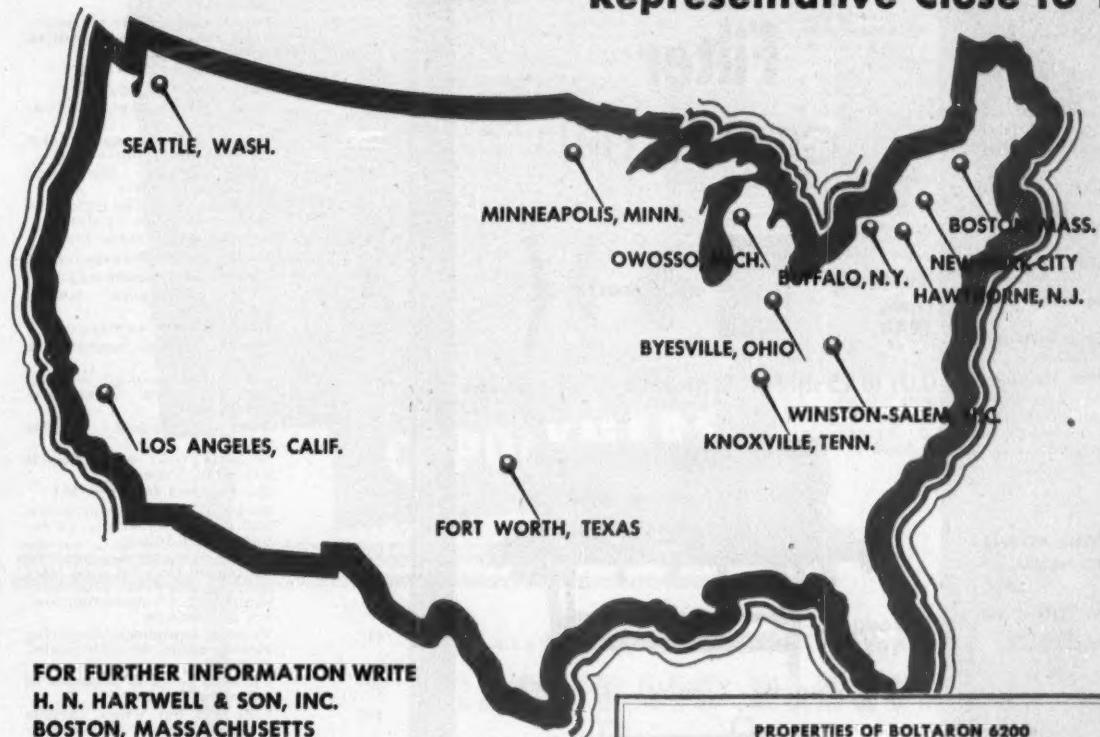
Placement of the test specimen is also important. In some cases the stainless under examination can be used as an actual part of the old operating equipment (a pump shaft, or the section of a pump line). If this is done, however, allowance should be made for interference effects from galvanic action set up between different metals or from corrosion products of the materials already being used.

The charts that are included with subsequent articles in this series are not such on-the-spot tests. Their virtue is that they condense much relevant corrosion data and present it in convenient form. They are designed (for the most part) for preliminary screening only. No reliance should be placed

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TO YOUR CORROSION PROBLEMS**

from the *Boltaron*  
6200

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**BOSTON, MASSACHUSETTS**

**Boltaron 6200** is the outstanding corrosion-resistant material on the market. It retains the properties of unmodified, rigid, unplasticized Polyvinyl-Chloride.

Our fabricators have been thoroughly trained to make the most efficient use of Boltaron 6200. They are fully qualified to design and fabricate economical corrosion-resistant Boltaron 6200 systems.

#### Available Forms of Boltaron 6200

**Sheets** — Size 30" x 60" (approximately); Thickness 1/32" to 1". **Rod Stock** — (10' lengths) 1/4" to 2". **Pipe** — (10' and 20' lengths) 1/4" to 3". **Fittings** — (Standard, threaded I.P.S.) 1/4" to 2".

#### PARTIAL LIST OF USES

Electroplating	Food Processing
Anodizing	Dairy Products Processing
Dyeing & Bleaching	Textile Processing
Tanning	Photographic Processing
Brewing	Industrial Plumbing

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#### PROPERTIES OF BOLTARON 6200

**Chemical Properties** — Outstanding chemical resistance to organic and inorganic acids, alkalies, alcohol and foodstuffs. Laboratory tests are continuously carried on. Specific information available on request.

**Mechanical Properties** — Boltaron 6200 is non-toxic, may be drawn, formed, molded and machined . . . and can be welded by the hot air method.

Physical Properties:	ASTM Method
Specific Gravity	D792-48T
Tensile Strength — psi	D638-49T
Modulus of Elasticity in Tension — psi	D638-49T
Flexural Strength — psi	D671-49T
Compressive Strength — psi	D695-49T
Hardness (Rockwell)	D785-48T
Heat Distortion $^{\circ}\text{F}$ — 66 psi (Maximum Useful Temperature)	D648-45T
Coefficient of Linear Expansion inch/inch/ $^{\circ}\text{C}$	D694-44
Thermal Conductivity Gal/sec/cm <sup>2</sup> / $^{\circ}\text{C}/\text{cm}$	C-177
Specific Heat Cal/gm/ $^{\circ}\text{C}$	4x10 <sup>-4</sup>
Dielectric Constant @ 1 megacycle	Calorific Method .24
Water Absorption % 24 hrs. @ 25 $^{\circ}\text{C}$	D150-47T
Flammability	D570-42 .05
	D568-48 Self Ext.

*Boltaron 6200 is manufactured in the United States*

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CORROSION FORUM, cont. . .

on such data for specific planning or manufacturing purposes.

Corrosion data are the beginning of the evaluation problem, and not the end. They must not be used blindly.

#### Typical Uses of Various Stainless Steels

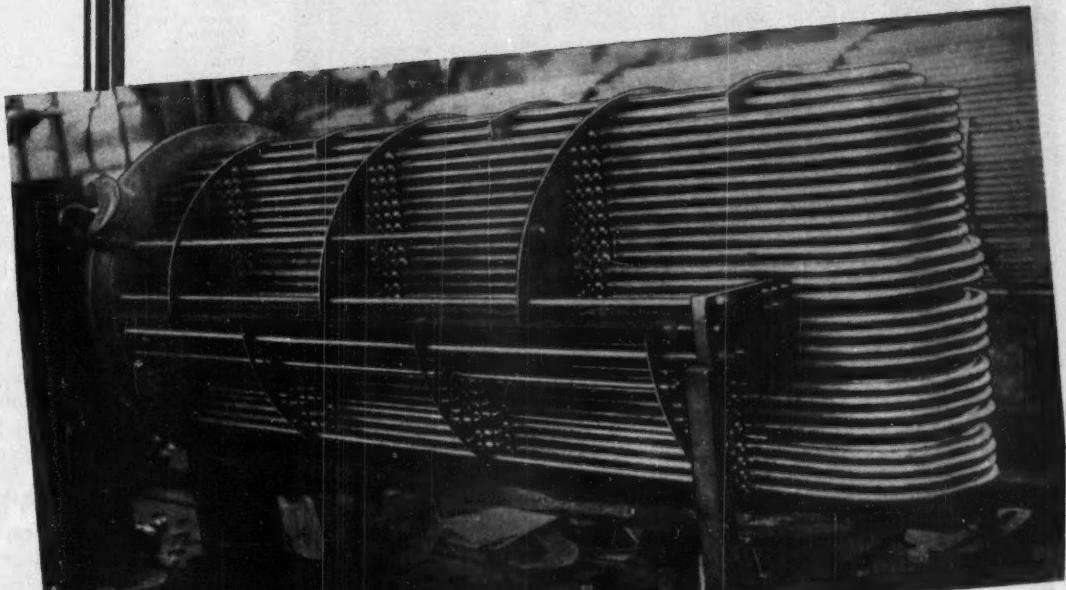
Type	Typical Uses
403	Steam turbine blades
405	Tower linings, baffles, separator towers
410	Bubble tower parts for petroleum refining, coal handling equipment
414	Beater bars, valve seats
416	Valve stems, plugs, gates
420	High spring temper applications
430	Nitric acid storage tanks, furnace parts, fan scrolls
430F	Pump shafts, instrument parts, valve parts
431	Products requiring high yield point, resistance to shock
440A, B, C	Cutting edges, shear blades
446	Burner baffles, furnace linings
301	Chutes for abrasive solids
302	Heat exchangers, towers, tanks, pipe
302B	Heaters, heat exchangers
303	Pumps, valves, instruments, fittings
304	Perforated blow-pit screens, heat exchanger tubing, pre-heater tubes
305	Funnels, utensils, circular hoods
308	Welding rod; more ductile welds for Type 430
309	Welding rod for Type 304
310	Jacketed, high temperature, high pressure reactors, oil refinery still tubes
316	Distillation and fractionating equipment for producing fatty acids, sulfite paper processing equipment, fractionating towers & internals
317	Process equipment involving strong acids or chlorinated solvents
321	Furnace parts in presence of corrosive fumes
347	Like 302 but where carbide precipitation during fabrication or service may be harmful

#### BOTH CAST AND WROUGHT FORMS

Both cast and wrought stainless steel will be used for equipment of many kinds. The data in these articles are based on AISI type numbers for wrought stainless steel.

An accompanying table lists the standard Alloy Casting Institute heat and corrosion-resistant casting alloys that closely resemble standard wrought stainless types. While limits on composition are not identical, the corrosion resistance displayed by similar alloys under similar conditions should correspond quite closely. Under severe conditions, this would require, of course, that the entire surfaces of castings be as smoothly finished as the wrought stainless surfaces now used for comparison.

(Corrosion Forum Continued)



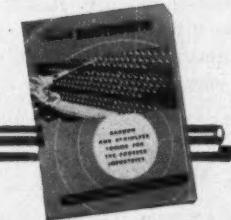
*In this bent-tube heat exchanger, the uniform ductility of Republic ELECTRUNITE Tubes assures smooth "U" bends that will not restrict flow.*

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**REPUBLIC ELECTRUNITE**  
Heat Exchanger Tubes

● At almost all stages in the production of copolymers, Republic ELECTRUNITE Tubes are used in heaters, condensers, and other types of heat exchange equipment.

The ELECTRUNITE process of making carbon and stainless electric-weld tubing from uniformly flat steel assures you of tubes that are concentric, uniform in wall thickness, and uniform in diameter all around the tube, and from end to end. Republic ELECTRUNITE Tubes can be smoothly bent even to short radii. Full-normalized treatment makes them uniformly ductile for predictable roller-expansion in the tube sheets.

Specify Republic ELECTRUNITE Heat Exchanger Tubes. Equally economical on new equipment or for retubing.



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Hydrochloric acid manufacturing plant with quartz equipment.

## Fused Quartz

**Applications in the CPI, physical and mechanical properties, and the chemical resistance of this material of construction.**

**JOSEPH GIALANELLA**

**Chief Engineer, Amersil Co., East Newark, N. J.**

Quartz or silica ( $\text{SiO}_2$ ), is one of the most common of all materials. This mineral in its combined and uncombined states forms about 60 percent of the earth's crust.

Pure silicon dioxide is colorless to white, and may be crystalline or amorphous. Sand is the most familiar form. Pure crystalline quartz is colorless and transparent, and is known as rock crystal.

Sand and rock crystals are the raw materials used for fabricating articles of fused quartz and silica.

Three types of quartz are manufactured—clear transparent, opaque and translucent. All types possess unique properties which make them valuable in most cases when extreme thermal, chemical, optical and electrical conditions are encountered.

Fusing silica sand or rock crystals in an electric furnace changes their crystalline formations into an amorphous or non-crystalline structure having many unusual characteristics. While in this amorphous condition the material can be readily drawn, blown, molded or otherwise fabricated in a variety of shapes and forms.

Fused quartz is also available as a wool whose fibers average 0.0004 in. It is an excellent insulation material capable of withstanding temperatures up to 3,000 deg. F.

### Ratio of Expansion Coefficients

Fused quartz	1
Carbon	2
Pyrex glass	6
Porcelain	6
Tungsten	9
Hard glass	10
Tantalum	11
Flint glass	14
Graphite	14
Plate & crown glass	16
Platinum	17
Cast iron	18
Copper	34

Quartz possesses the unusual property of providing transparency over practically the entire spectrum, affording visibility under high temperature operating conditions and permitting free transmission of ultra-violet light. In photo-chemistry, transparent quartz apparatus serves many useful purposes in the investigation of photochemical reactions affected by ultra-violet rays.

### LOW COEFFICIENT OF EXPANSION

The coefficient of expansion of quartz is  $0.54 \times 10^{-6}$  which gives it a remarkable resistance to extreme and rapid changes in temperature. Small articles may be heated to white heat and immersed in cold water without damage.

Larger vessels and pipe also withstand rapidly changing temperatures, provided the heating or cooling is applied fairly uniformly over their entire surfaces. Exothermic reactions can be carried out in quartz apparatus with perfect safety. When fused silica or fused quartz tubes or retorts are used for endothermic processes various portions of the same apparatus may be maintained at widely varying temperatures.

Because of their negligible expansion, quartz products do not alter in volume at temperatures reached in use of pyrometers, hydrometers, manometers, etc., or when used at higher

### APPLICATIONS IN THE CPI

Quartz lends itself to the following uses:

Ammonia oxidation

Chlorinating or carbonating reactions with phosgene

Chlorination of methane

Distillation of formic, perchloric and nitric acids

Hydrochloric acid cooling and absorption plants

Mercuric chloride manufacture

Nitric acid condensers

Preparation of hydrochloric and hydrobromic acids

Purifying hydrogen from oxygen

Purifying nitrogen from oxygen

Sulphuric acid concentrators

### Addition to Directory of Coatings Manufacturers

Add the following to the Directory of Trade Names and Producers, p. 171 of the December 1952 report on pro-

tective coatings (fifteenth materials of construction issue). They are products of the CarboLine Co., St. Louis, Mo.

Trade Name	Basic Resin Type	Thickness Category*
Polyclads	Vinyl	Coating
B Resin	Furan	Coating, mastic
Chlorclad M 4	Butadiene-styrene	Coating
Phenolines 300 & 315	Modified phenolic	Mastic, lining
PhenoLine 213	Modified phenolic	Mastic
Epolines	Epoxy	Coating, mastic
Carbo-Kote 6020	Furan	Mastic
Neoprene 100	Neoprene	Mastic, lining
Neoprene 60	Neoprene	Coating
Fluorline 100	Fluorinated polyvinylidene	Coating

\* Coatings are considered here to be dried films less than 10 mils in thickness, mastics between 10 mils and  $\frac{1}{8}$  in., linings over  $\frac{1}{8}$  in.

# from theory to practice

Laboratory research men working with ozone are already convinced that the next decade will bring forth even broader applications for ozone as yet undreamed of by practical production men.

Tonage Ozone in Chemical Processing, Chemical Industries, September, 1950

## Ozone Gets a Big Chemical Job

Emery develops a brand new process that'll up output of azelaic and pelargonic acids, lower costs, improve quality. It'll be ozone's biggest job yet.

Chemical Engineering, September, 1952.

There's a new ozone process that's already proved its value in the most important applications. But there are many more uses—and in a number of industries where ozone has not yet been used—there's bound to be a daily increased appreciation. But, just as ozone does today, in a number of industries, ozone has proved itself to be versatile and valuable. And, at this point of time—with no less than 100 ozone plants now operating commercially and another 200 under construction—there's no question that ozone is here to stay.

These are other reasons why ozone has become the oxidant of choice. In addition, problems such as low holding, no storage expense, and no regeneration charges, because it is generated right where you need it. Whether you're in oilfield operations, you'll find an application where ozone can be used effectively, efficiently and at a lower cost. In chemical processing, in ozone purification, in industry, ozone is here to stay. And with ozone has come a place in industry that's never been available before.

If you need  
a versatile oxidant...  
investigate

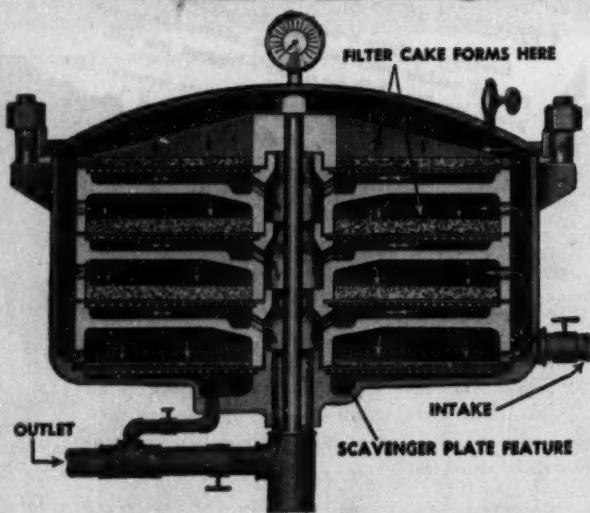


**THE WELSBACH CORPORATION**  
ZONE PROCESSES DIVISION  
1500 WALNUT STREET, PHILADELPHIA 5, PA.

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Any kind of filter media, paper, cloths, or screens with any grade of filter aid can be used with maximum efficiency because the problem of cake stability is never a consideration with Sparkler Horizontal Plate Filters.

Fine sharp filtration is obtained right from the start and continued up to the end of the filtering cycle.

The filter cake built up on a Sparkler Horizontal Plate is always uniform in thickness and porosity over the entire plate. Flow is with gravity, and the filter aid is floated into position and distributed evenly over the entire surface.

This is why users of Sparkler Filters are free from filter cake trouble.

# SPARKLER

MANUFACTURING CO., Mundelein, Ill.

Sparkler International Ltd.  
Prinsengracht 876  
Amsterdam, Holland

Sparkler Western Hemisphere Corp.  
Mundelein, Ill., U.S.A.

SERVICE REPRESENTATIVES IN PRINCIPAL CITIES

# SPARKLER FILTERS·SPARKLER FILTERS

CORROSION FORUM, cont. . .

### Physical Properties of Quartz

Property	Clean Fused Quartz	Fused Quartz	Translucent Units
Specific gravity	2.2	2.07	
Hardness	4.9	4.9	Mohs scale
Tensile strength	4,000	1,000	lb./in. <sup>2</sup>
	45,000	26,000	
(Fiber)	(Fiber)		
Crushing strength	2.1×10 <sup>6</sup>	1.4×10 <sup>6</sup>	" "
Poisson's ratio	0.14	0.14	" "
Modulus of elasticity	10.1×10 <sup>10</sup>	10.1×10 <sup>10</sup>	" "
Modulus of shear	4.3×10 <sup>6</sup>	4.3×10 <sup>6</sup>	" "
Coefficient of thermal expansion	0.54×10 <sup>-6</sup>	0.54×10 <sup>-6</sup>	cm./cm./°C.
Thermal conductivity	0.0033	0.0025	cal./sec./cm. <sup>2</sup> /°C.
Specific heat	0.18	0.18	cal./°C./gm.
Dielectric constant	4.1	4.1	Measured at 60 cycles
Dielectric loss factor	0.0009	0.0009	Measured at 10,000 volts, 100 kilocycles
Power factor	0.00023	0.00023	" "
Dielectric strength	410	3.96	Volts/mil
Resistivity	1×10 <sup>18</sup>	1×10 <sup>18</sup>	Ohms/cm. <sup>2</sup> at 500 volts

temperatures in mercury or gas thermometers or thermostats. In laboratory work where special glass or porcelain will not stand up, or in many uses where metals have been formerly used, quartz gives excellent results.

### HEAT RESISTANCE

Fused quartz has a melting point of approximately 1,756 deg. C.; but it softens at about 1,670 deg. C. Even at the melting point, it is still very viscous which makes fabrication into various shapes difficult. Special equipment and technique are employed in manufacturing fused quartz products.

One of the chief advantages of quartz products is their ability to withstand temperatures up to 1,500 deg. C. for short periods. They can be used continuously, regardless of temperature changes, at temperatures up to 1,000 deg. C.

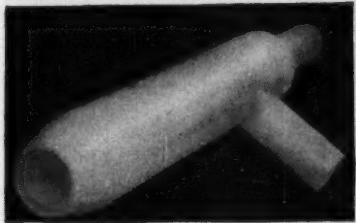
### CHEMICAL RESISTANCE

Quartz is chemically inert to practically all chemical solvents with the exception of two acids and hot alkaline solutions. A brief summation of the effects of various materials on quartz is given below:

**Acids**—Organic or inorganic acids have no effect on fused quartz. Exceptions are hydrofluoric acid, and phosphoric acid at temperatures above 150 deg. C. Quartz is attacked at a lesser degree by these acids than glass or ceramics.

**Halogens**—Quartz products are highly resistant to the halogens with the exception of fluorine.

**Alkalies**—Solutions of caustic soda and similar alkalies have a slight effect on quartz at room temperature but at



Quartz gas burner

high temperatures the effect is more pronounced. Fused alkalis will attack fused silica rapidly.

**Metals**—Most pure molten metals such as lead, copper and iron will not attack fused quartz equipment.

**Metal Oxides**—Some will attack fused silica or fused quartz articles, forming slag at extremely high temperatures.

**Basic Metal Compounds**—Will attack fused quartz articles rapidly at temperatures approaching the melting point of the mixture.

#### MECHANICAL STRENGTH

Transparent fused quartz has an ultimate tensile stress of 4,000 psi. and a compressive (crushing) strength of 210,000 psi. Translucent quartz has an ultimate tensile and crushing strength of 1,000 psi. and 140,000 psi. respectively.

Modulus of elasticity of fused quartz is approximately  $10.1 \times 10^6$ . Fibers of fused quartz have considerably higher ultimate stress values than those articles of larger sections.

Quartz also possesses great torsional elasticity so that when fibers are twisted through a given angle, they will return to the initial unstressed position after the load has been released. This property makes it valuable for use in some types of instruments.

The mechanical strength of fused quartz unlike metals increases with temperature up to 1,000 deg. C. Above this temperature its strength decreases sharply. For instance at 1,800 deg. F. the bending strength increases 43 percent while at 2,200 deg. F. it reduces 34 percent.

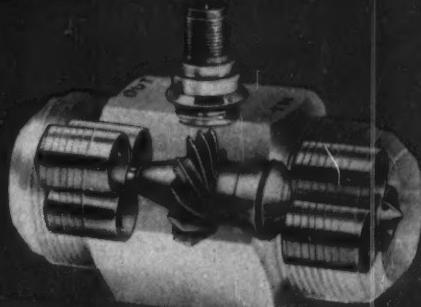
#### Notice . . .

The Corrosion Forum series of corrosion data presentations in chart form will be continued next month.

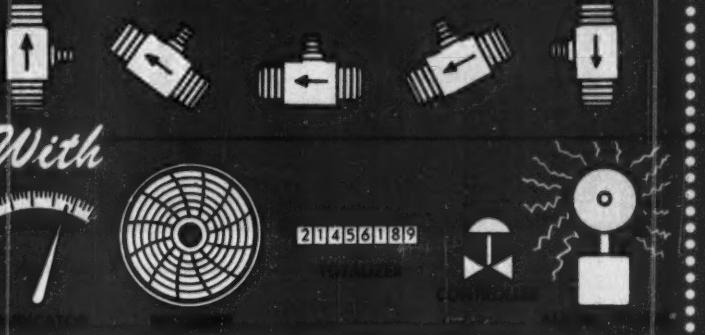
The common types of stainless steels will then appear, one each month. These will be followed by the highly-alloyed stainless steels.

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NEW WAY TO MEASURE  
*Flow*

LINEAR • ACCURATE WITHIN  $\frac{1}{2}\%$  • EASILY INSTALLED • OPERATES TO 35,000 PSI  
HANDLES ACIDS, CAUSTICS, SUSPENSIONS AT HIGH OR LOW TEMPERATURES



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The Potter Flow Element is inherently linear and is accurate within  $\pm\frac{1}{2}\%$  over the recommended range. It can be built of any non-reactive materials for handling acids, caustics and corrosive materials.

It will operate at elevated pressures—up to 35,000 psi; and is quickly and easily installed in existing piping...vertically, horizontally or at an angle.

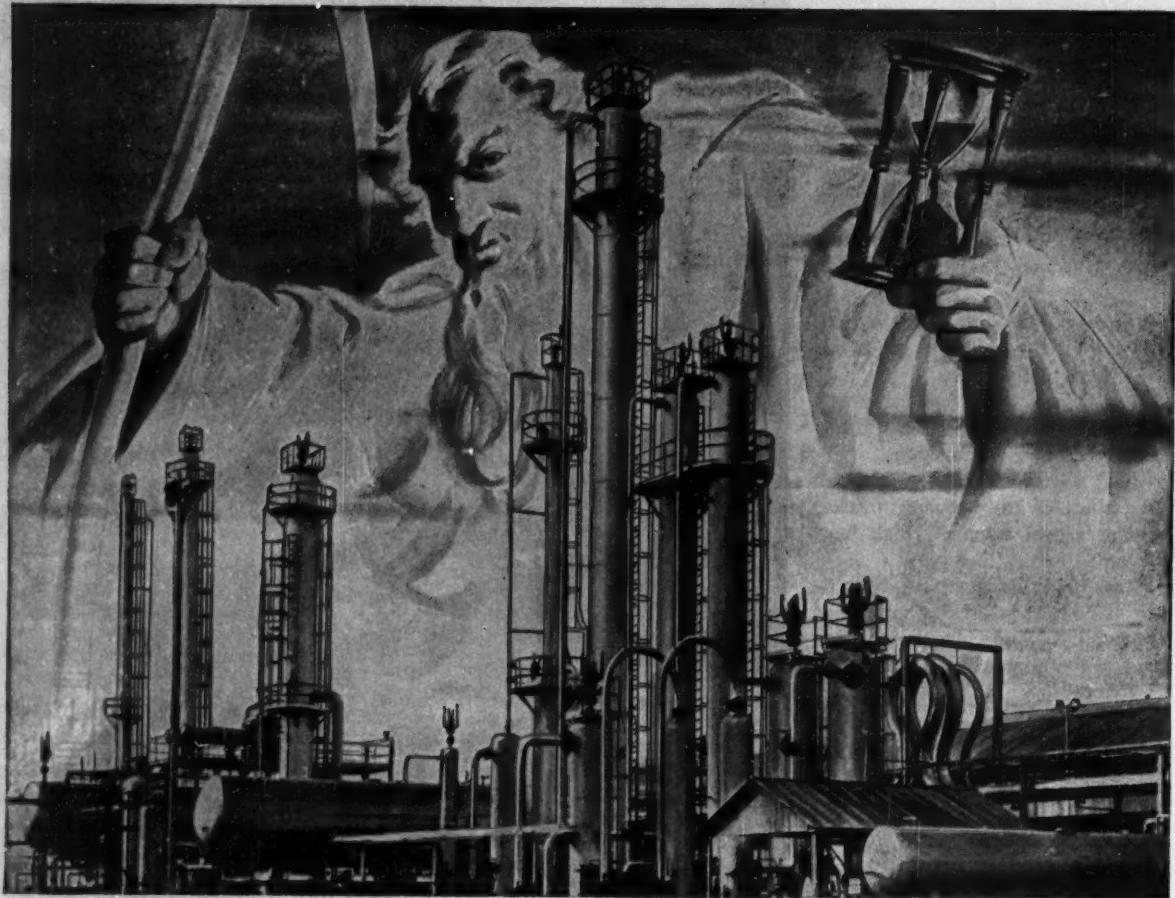
Repeatability is as high as 20-to-1, while the pressure drop through the unit is usually less than 1 psi at maximum flow. The flow element can be used in systems which the system pressure operates from  $-450^\circ$  to  $+1200^\circ\text{F}$ . Flow is measured in either weight or volume units.

Instrument accessories include ratio indicators, various types of recorders incorporating electric or pneumatic converters, or both, for ratio or mixing control. High accuracy is obtained with totalizing systems which can be applied to automatically start and stop flow from sensors or those repetitive sources for batch mixing applications.

WRITE FOR INFORMATION to learn how this new method of measuring flow can be used to solve your piping problems.

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## The Ultimate JUDGE is TIME

**Smithlined** vessels have been in continuous corrosive service for over 20 years without failure of the lining attachment or the vessel itself.

This history of service is significant. It confirms the findings of our own research laboratories and supports the designs of our engineers, that closely controlled resistance-welding of stainless or other corrosion resistant liners to carbon steel vessel walls is the best means of providing long-

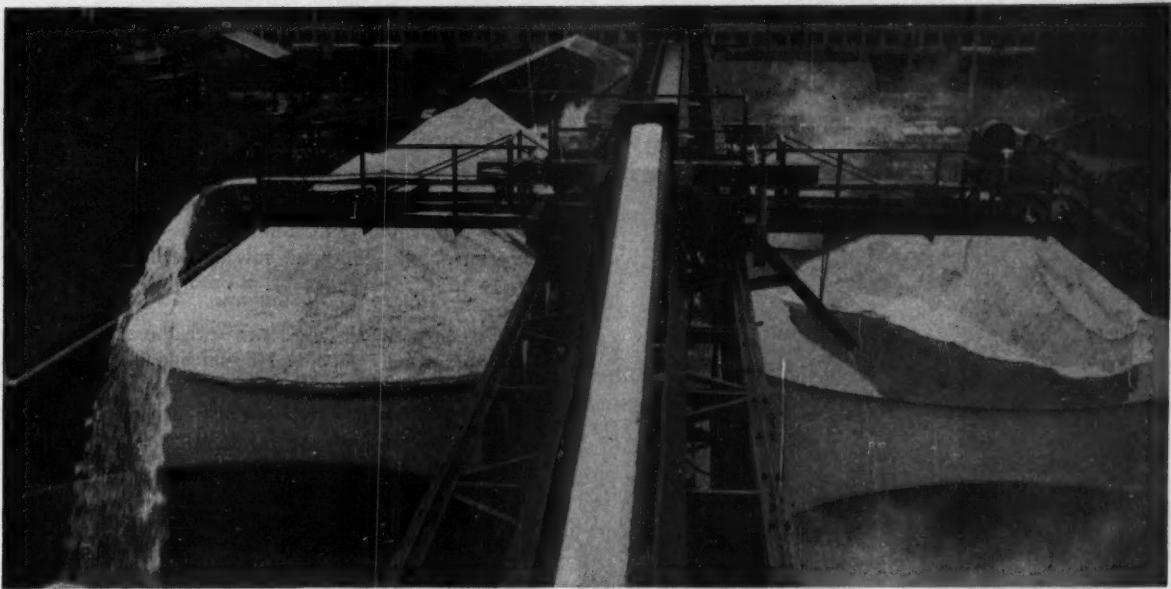
term service and satisfactory performance under specific corrosion, pressure and temperature conditions.

If you have a corrosion problem, let A. O. Smith work with you in solving it. Our engineers and laboratories have an unequalled background of experience and data gained from hundreds of successful applications of Smithlining. Contact our nearest district office.



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tion that will follow through on every detail. This includes supplying all related equipment . . . building supporting structures and enclosures . . . erecting the complete job, if desired.

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TRIPPERS

COMPLETE  
TERMINAL  
MACHINERY





**Man of the month:**

## Eger V. Murphree

**President of Standard Oil Development, he is the 1953 recipient of the Industrial Research Institute Medal.**

Standard Oil Development's president, E. V. Murphree, is a man with a deep interest in his work. Nevertheless, people meeting him at a social function can tell you he was pleasant, congenial, and enjoying himself. As they get to know him better, they quickly learn of his genuine consideration of friends and fellow employees. Although he is reserved, others do not find it at all difficult to become acquainted with him.

His characteristics and informal attitude have percolated down through the company he heads. There is little standing-on-ceremony at Standard Oil Development. Most employees who come in contact with the president call him "Murph."

Outside of work, golf is probably one of his chief interests. He has compiled a fairly extensive collection of classical music recordings and is enthusiastic in his appreciation of fine music.

His one extreme characteristic is the intensity of his

**Clark E. Center.** Vice president of Carbide and Carbon Chemicals Co. in charge of atomic energy work. Has been Carbide's general manager of atomic energy operations.

**Joel H. Hildebrand.** Winner of the 1953 Willard Gibbs Medal of ACS's Chicago section. Professor

of chemistry at the University of California. A member of the faculty since 1913.

**Richard C. McCurdy.** President of Shell Chemical Corp., New York. Has been general manager of the Royal Dutch Shell Cos. in Venezuela. Stanford graduate.

**R. Lindley Murray.** Honorary member of the American Institute of Chemists. President of Hooker Electrochemical Co.

**Thomas H. Chilton.** Chairman of the Engineering manpower commission of the Engineers Joint Council. Technical director, engi-

interest in his work. Most recent recognition of the results is the Industrial Research Institute's Medal which honors "outstanding accomplishment in leadership or management of industrial research which contributes broadly to the development of industry or the public welfare."

He has maintained close touch with the actual research being done in his company. He somehow always manages to be present at its research coordination meetings. He does this despite the heavy administrative burdens of the presidency and his positions as president of the Permanent Council of the World Petroleum and a member of the advisory committee of AEC.

Mr. Murphree began his career in science at Kentucky University where he majored in chemistry and mathematics. In addition to his scholastic activities he was voted All-Southern tackle on the football team and captained the team in 1920. Following his graduation from Kentucky in 1920 he remained another year for graduate work in chemistry and obtained an M.S. degree in 1921. Combining his interest in science and football, he next accepted a position as physics and math instructor and football coach at an Illinois high school.

The following year he went to MIT where he remained until 1924, first as staff assistant and later as research associate in the laboratory of applied science. He next took a job as chemical engineer with Solvay Process Co. By 1926 he was in charge of the chemical engineering division at Solvay and directed and expanded activities of the company on studies of distillation, absorption, filtration, drying and heat transfer.

In 1930 Mr. Murphree left Solvay to join Standard Oil (New Jersey) as director of a new group organized to develop chemical processes utilizing petroleum raw materials. Two years later his duties were expanded to include all development and research work at Baton Rouge, when he was named director of the development and research department of the Standard Oil Co. of Louisiana. In 1934 he was elected vice president and director of Hydro Engineering and Chemical Co. In 1934, he was transferred to New York as manager of development and research for the Standard Oil Development Co. In 1937 he was elected vice president, in 1946 executive vice president and in 1947 president.

Fluid catalytic cracking, 100 octane gasoline, synthetic toluene, butadiene and hydrocarbon synthesis, to name only a few, are fields which have felt the impact of Mr. Murphree's thinking.

The patented Turba-Film Evaporator (Luwa Process, Switzerland) processes liquids, slurries and gases . . . especially heat-sensitive or heavy viscous materials . . . by an advanced-

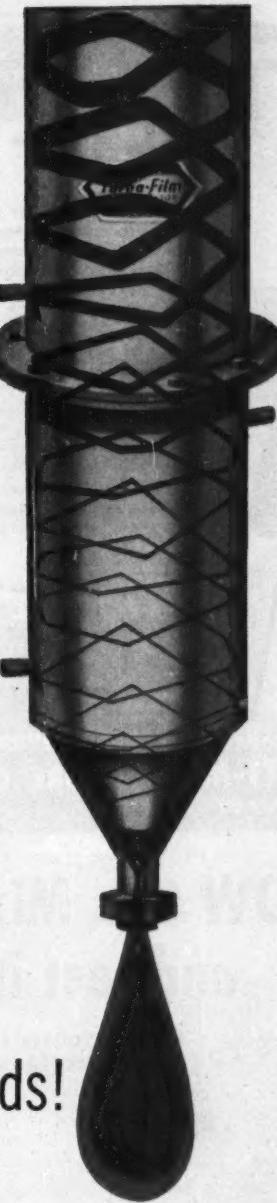
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design, thin-film principle of evaporation. It completely overcomes the disadvantages found in the ordinary falling thin-film systems. By creating *turbulence* in the thin film, localized overheating is prevented; foaming and frothing difficulties are overcome, and desired concentration is achieved in a single, few-second pass. And where only vapors are wanted, tests show distillation up to 99%!

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### NAMES IN THE NEWS, cont. . .

neering department of E. I. du Pont de Nemours & Co. with whom he has been associated since 1925.

**A. T. Fiore.** Coordinator of new product development and service laboratories, Givaudan-Delawanna, Inc. and its affiliate, Sindar Corp. Joined Givaudan 20 years ago as a chemist in charge of the analytical department. Since 1934, a research associate. Chemistry graduate of Fordham.



A. T. Fiore



James T. Sheehy

**James T. Sheehy.** New member of the board of directors, Rayonier Corp. Executive vice president since 1951. Company history: joined in 1933 as a pulp tester; mill control chemist, assistant chief chemist, chief chemist, assistant plant manager; plant manager of the company's Fernandina, Fla., division. Chemical engineering graduate of the University of Washington.

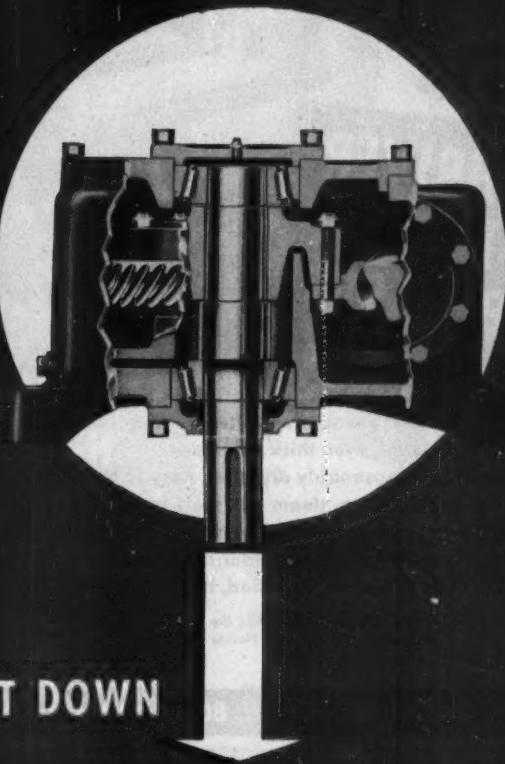
**S. D. Kirkpatrick.** Elected chairman of AEC's advisory committee on industrial information. Has served as chairman of the group since it was established in 1949, having been appointed originally by the AEC general manager. Vice president of the McGraw-Hill Book Co.; editorial director of Chemical Engineering and Chemical Week.

**Robert M. Burns.** To receive the 1953 Willis Rodney Whitney Award of the National Assn. of Corrosion Engineers. Chemical coordinator and director of chemical and metallurgical research for Bell Telephone Laboratories at Murray Hill, N. J. Joined the Laboratories upon their organization in 1925.

**A. C. Hobbie.** Manager of the Corona Chemical Div., Pittsburgh Plate Glass Co. Has been manager of the division's micronized products

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MIXERS  
AND OTHER  
VERTICAL DRIVES*

SHAFT UP  
OR  
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*Worm Gear Reducers*

Matching high quality with distinctive design, these Philadelphia units offer a combination of construction features not found in any other worm gear reducer. Indicative of these unusual advantages is the famous "dry well" construction of the shaft-downward type. This feature completely eliminates the necessity of depending on a stuffing box or oil seal to prevent oil dripping down the shaft.

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Type AU      Type C

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W. H. **NICHOLSON** & CO.  
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### NAMES IN THE NEWS, cont. . .

department at Moorestown, N. J. Joined the company in 1949. Previously affiliated for ten years with the International Pulverizing Corp. as chief engineer and plant manager and for a two-year period with Distillation Products, Inc., as chief designer.

**Hugh A. Neal.** Manager of the new petrochemical division of Air Products, Inc. Has been in the field of tonnage oxygen and oxidation of light hydrocarbons for the past several years. Graduate of Oklahoma University.



Hugh A. Neal



C. H. Kollenberg

**C. H. Kollenberg.** Assistant head, technical service division of Baytown, Texas refinery, Humble Oil & Refining Co. For the past eight years he has been a section head specializing in cracking, hydro-forming, treating, operation analysis and utilities at different times. Doctorate in chemical engineering from the University of Texas.

**John B. Merrill.** Vice president in charge of metallurgical and chemical operations, Sylvania Electric Products Inc., New York. Has been a vice president since 1951. Joined the organization in 1941.

**James S. Walker.** Manager of technical service, Hooker Electrochemical Co. Has been technical service supervisor since 1950. With the company since 1940.

**K. O. Schleitner.** From assistant manager-research to manager-heating research, National Radiator Co. Came to the company in 1946 as a metallurgist and chemist. Doctorate from the University of Illinois.

**M. W. Gaylord.** Assistant manager, research administration section, research department, Koppers Co.

Since 1949, production manager of the gas and coke division. Joined Koppers in 1939 as a cadet engineer at the company's St. Paul, Minn., plant.

**Robert Jenness.** Recipient of the Borden Award presented by ACS for his outstanding research on non-fat dry milk products. Associate professor of agricultural biochemistry at the University of Minnesota.

**William F. Talbot.** Vice president of the Rubberset Co., Newark, N. J. Continues in charge of the company's plastic products division and as director of its research and development program. Until 1952 he was in charge of a group of scientists engaged in large scale field testing of chemical, bacteriological and radiological weapons for the Chemical Corps of the Army.

**William Rostoker.** Senior metallurgist, Armour Research Foundation, Illinois Institute of Technology. Joined the foundation in 1951. Previously a lecturer at the University of Birmingham, Birmingham, England.

**P. H. Groggins.** General chemical consultant, administrative office for the chemical divisions of Food Machinery and Chemical Corp. Recently retired from a 26-year term of service in the employ of the government where he had long been connected with the department of agriculture and, more recently with NPA.

**William G. Christy.** Has opened an office as consulting engineer at 34 Park Row, New York. Has been director of New York's bureau of smoke control since 1950.

**Ray E. Heiks.** Supervisor of Battelle Institute's solid-state chemistry laboratories. Has been on the Battelle staff for ten years.

**J. Rae Stirrat.** Manager of the newly-established marketing research and product planning section of General Electric's chemical division. In charge of product planning activities since 1951. Came to the company in 1943 as a chemist in the new products development laboratory. Previously with Standard Oil of New Jersey. (Continued)



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- Lightweight
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Manufactured in a complete range of sizes, single and multi-pass, fixed tube and removable tube bundle, the units are built of ferrous or non-ferrous metals. Write for Catalogs 1049 and 1149.

NAMES IN THE NEWS, cont. . .

**Hans Beller.** Manager of the recently established process engineering department and semi-works of the Grasselli plant of General Aniline & Film Corp., Linden, N. J. Formerly manager of the special products and sulphur codors-textiles auxiliaries area, he was technical director of the new fields department. Joined the company in 1941. Other company employees transferred to administrative posts in the new department: Walter N. Alexander, supervisor, planning section; Frederick Grosser, supervisor, laboratories section; Robert M. Verburg, supervisor, semi-works; Clyde McKinley, superintendent, process engineering section; Charles F. Montross supervisor of the process evaluation group of the process engineering section; Herman H. Tiedemann, supervisor of the development group in the process engineering section.



Hans Beller

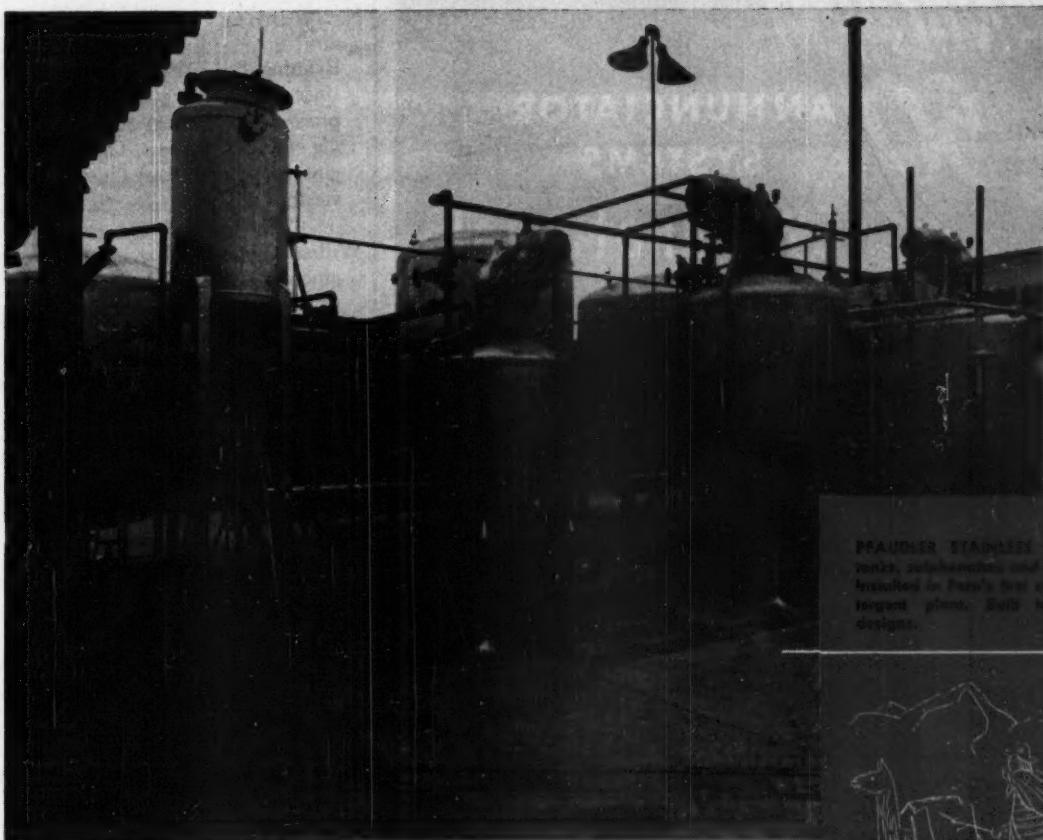


Raymond A. Swain

**Raymond A. Swain.** Manager of the Kankakee, Ill., plant of American-Marietta Co., Chicago. For the past six years, director of research and general superintendent, Patterson-Sargent Co. Before that he was in charge of the synthetic resin and varnish development laboratories of the Interchemical Corp. Studied chemical engineering at the universities of Cincinnati, Chicago and at Yale.

**Louis S. Deitz, Jr.** Technical advisor to the Climax Molybdenum Co., New York. For the past 23 years, development and works engineer for Western Electric and its affiliate, Nassau Smelting & Refining Co.

**Alvin H. Ross.** Assistant to the vice president and general manager of Climax Uranium Co., New York. Has been manager of refining operations for El Dorado Mining &



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designs.



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**3. ENGINEERED AGITATION**—Whether your process involves gas absorption, emulsification or suspension of solids—Pfaudler has developed formulae

and equipment to take the guesswork out of solving agitation problems.

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## NAMES IN THE NEWS, cont. . .

Refining Ltd. With the company since 1939 engaged in research, process development and the refining of radioactive ores. Chemical engineering graduate of Queens University.

**Wilfred Gains.** Project engineer, engineering division, Vulcan Copper & Supply Co. To be engaged in the design and construction of high pressure synthesis plants. Has been associated with Chemical Construction Corp., New York, for the past 12 years. New development engineer with Vulcan: **Allan Hokanson.** Formerly with the research and development department of Colgate-Palmolive-Peet Co.



Wilfred Gains



Allan Hokanson

**Charles R. Bragdon.** Consulting chemical engineer in Larchmont, N. Y., specializing in work relating to the organic surface coating industries. Recently retired from Interchemical Corp. after more than 37 years' service with it and its predecessor, the Ault and Wiborg Co.

**Edward A. Mihok.** New member of the research staff of Timber Engineering Co., Washington, D. C. Has been engaged in forest research for the U. S. Forest Service.

**Aubrey R. McKinney.** Group leader of physical chemistry, Chemstrand Corp. Previous employers: National Aniline Div., Magnolia Petroleum Co., Dallas Laboratories, American Bemberg Corp. Doctorate in chemistry from Texas University.

**Norris Boehmer.** Project chemical engineer of Monsanto's organic chemicals division engineering department in St. Louis. Has been production superintendent at the company's Nitro, W. Va., plant. His successor: **Walter J. Meyer**

who has been a general superintendent at the John F. Queeny plant. New Queeny superintendent: Robert E. Soden who has been area supervisor at Nitro.

**Robert Johnson.** Technical supervisor, intermediates area at the Chemstrand Corp. nylon manufacturing and processing facilities now under construction at Pensacola, Fla. Previous jobs: senior research fellow at Mellon Institute for 11 years; researcher for Du Pont; professor at the University of Illinois.

**M. J. Blish.** Recipient of the University of Minnesota's outstanding achievement award. Supervisor of organic and biochemical research for International Minerals & Chemical Corp.

**Thomas D. Bolt.** New staff member of the research and development department, Godfrey L. Cabot, Inc., Boston. Formerly with Gates Rubber Co.

**Justo Bravo.** To work in the inorganic research department at Wyandotte Chemicals Corp., Wyandotte, Mich. Doctorate from Kansas University.

**James O. Harris.** Research group leader at the Nitro, W. Va., laboratory of Monsanto's organic chemicals division. Has been a research chemist there since 1950. Joined the company's phosphate division in 1943. Doctorate from the University of Tennessee.

**Richard Creasy.** Assistant chief engineer for Virginia-Carolina Chemical Co. at Nichols, Fla., where the company is designing and constructing a new plant to mine and process phosphate. Formerly chief engineer of Georgia Iron Works.

**H. A. Swen.** Vice president and manager of Texas Gulf Sulphur Co. Joined the engineering department of the company in 1919 and since 1942 has been assistant general manager.

**D. Y. Miller.** New member of the market development department, textile division, Celanese Corp. of America. Has been engaged in technical control work in the company's New York office since 1945.

# AMMUNITION

for an  
IDEA MAN



Photomicrograph of Nalco HCR



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## NAMES IN THE NEWS, cont. . .

Joined Celanese in 1938 as a member of its research and development staff at its Cumberland, Md., plant. Graduate of Lehigh.

**Jack H. Waggoner.** Technical assistant to the general manager, Pittsburgh Plate Glass Co's fiber glass division. Has been technical assistant to the executive vice president of Owen-Corning Fiberglas Corp. Studied at the universities of Kansas and Pittsburgh and MIT.



Jack H. Waggoner



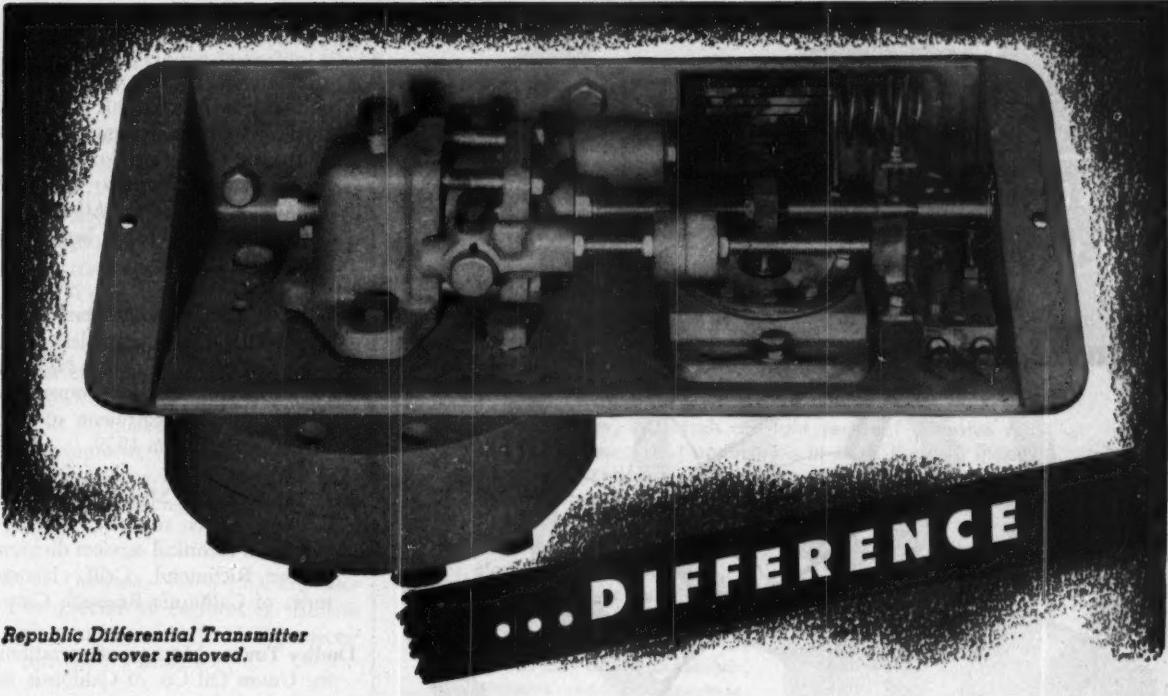
Henry P. Wickham

**Henry P. Wickham.** To manage the expanded operating division of M. W. Kellogg Co. Long associated with Kellogg's fluid catalytic processing developments. New manager of the company's project engineering department: R. V. Becknell, formerly a project manager. New associate manager: O. G. Melchior who has been a project manager.

**Reginald J. S. Pigott.** President of the Engineers Joint Council. Consultant to the Gulf Research and Development Co.; recently retired as chief engineer, director of engineering division of the Gulf company in charge of engineering research. Former president of ASME.

**Leo Brewer.** Recipient of the 1953 Leo Hendrik Baekeland Award of ACS's north Jersey section. Associate professor of chemistry in the University of California Radiation Laboratory; consultant to the AEC. Before joining the California faculty in 1946 he served as a chemist on the atomic bomb project for three years.

**O. M. Walstad.** Plant manager, Atlass, Mo., plant of Thurston Chemical Co. of Joplin, Mo. Formerly served as production superintendent for all company plants. New



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with cover removed.

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superintendent of the chemical section at the Atlas plant: James A. Doyle who was formerly with Mathieson Chemical Co. New assistant superintendent for the chemical section at the Atlas plant: Bert W. Crow who has been with Standard Oil.

**Walter W. Ethier, Jr.** Assistant director of Pittsburgh Plate Glass Co.'s paint and brush division at Newark, N. J. Started with the company in the technical department of the firm's paint plant in 1939.

**F. W. Kavanagh.** Manager of petroleum products research, development and technical services division at the Richmond, Calif., laboratories of California Research Corp.

**Dudley Tower.** Manager of operations for Union Oil Co. of California in its Gulf division with headquarters in Houston, has been elected a vice president.

**Theodore F. Thorsberg.** Representative of Dow Chemical Co. in Argentina. Has been assistant director of the company's main laboratory at Midland since 1948. Joined the company in 1929 as a chemist. Studied at the University of Michigan.

**Donald A. Krummel.** A new member of the research staff of Miner Laboratories, Chicago. Formerly with Glidden Co. Other new members: Ezra H. Bitcover, formerly with Lindsay Chemical Co.; Abraham Ravve, formerly with the Illinois Institute of Technology.

**R. C. Conn.** Departmental technical director in charge of textile resins process development and chairman of the technical committee of textile resins, Calco Chemical Division. Studied at West Virginia and New York universities.

**Everette M. Burdick.** Director of laboratories, American Chlorophyll Div., Strong Cobb & Co. Joined the company in 1952. Previously research chemist for the Dept. of Agriculture and earlier director of research, Texsun Citrus Exchange. New chief of the division's control department: Neil C. Spencer. Pre-

viously with the research department of the United States Finishing Co., Providence.

**R. V. Shankland.** Senior research associate in the research department at the Whiting, Ind., laboratory of Standard Oil Co. (Indiana). His successor as section leader on catalyst research and development: G. M. Webb.

**George A. Harrington.** Market research director, Indoil Chemical Co., Chicago. Formerly associated with Mallinckrodt Chemical Works' development activities prior to which he was with Socony Vacuum Oil Co.'s chemical products division.

**G. G. Crewson.** From chief engineer to director of engineering, Buffalo Electro-Chemical Co. His successor: J. N. Vermilya.

**Henry Ruegg.** Chairman of the board, Ultra Chemical Works, Inc., Paterson, N. J. Continues as general manager in charge of operations. New company president: William H. Spuhler who maintains his post of general sales manager. New treasurer and secretary: Albert Sharphouse who continues as technical director of the company.

#### OBITUARIES

**Charles H. Herty, Jr.**, 56, assistant to the vice president of Bethlehem Steel Co.'s steel division, died January 17. He had been with Bethlehem since 1937 and became widely known during World War II for his work on the conservation of manganese and other raw materials of steelmaking.

**Sherman B. Townsend**, 88, founder of W. B. McVicker Co., Brooklyn, died January 24.

**Paul W. Prutzman**, 76, manager of patents for General Petroleum from 1928 until his retirement in 1945, died in Los Angeles January 28.

**John Fulton**, 83, professor emeritus of chemistry at Oregon State College and a member of the faculty 47 years before retirement in 1940, died at Corvallis, Ore., February 1. He headed the chemistry department for 33 years. (Continued)

# IT'S NEW!

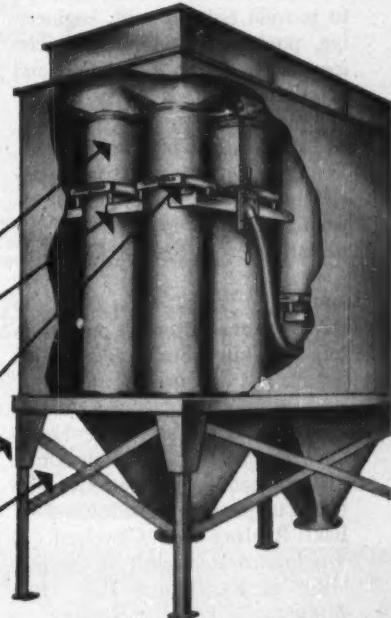
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# Industrial Notes

## NEW COMPANIES

**Sheffield Chemical Co.**, Norwich, N. Y., to make products for use by the chemical, pharmaceutical, food and other industries. It is a subsidiary of National Dairy Products Corp.

**Gustave M. Goldsmith**, Cincinnati, to do consulting in the field of structural engineering, plant layout and all phases of small equipment design.

**Pall Filtration Cos.**, Glen Cove, N. Y., to provide industry with engineering, production and research services in the fields of filtration and porous media.

**Sterwin Chemical of Canada Ltd.**, Windsor, Ont., to serve more efficiently and economically the expanding business in Canada of the parent company, Sterling Drug Inc.

**Hammond & Litell**, New York, to serve as patent attorneys and solicitors of United States and foreign patents and trademarks.

**Baker-Lull Corp.**, to produce heavy-duty industrial lift trucks and other material handling equipment. The new company is a subsidiary of Baker-Raulang Co., Cleveland. It was formed as a result of the purchase of the former Lull Mfg., Minneapolis, by Baker-Raulang.

**Stracho Engineering Corp.**, Shreveport, La., to serve the petroleum, power, chemical and allied industries in process piping and welding.

**J. D. Gould Co.**, Indianapolis, to manufacture electrically operated valves.

**Propel Chemicals, Inc.**, New York, to offer tested formulations to fillers and marketers in the field of aerosol products.

**Arapahoe Special Products, Inc.**, Boulder, Colo., to take over from the parent company, Arapahoe Chemicals, Inc., the operation, production and sale of all hazardous

processes and materials such as Grignard reagents and custom manufacturing via the Grignard reaction, and similar work involving highly volatile solvents.

**Molded Fiberglass Tray Co.**, Linesville, Pa., to specialize in the production of trays for the chemical industry.

**Barnebey-Cheney Co.**, Columbus, Ohio, to manufacture activated carbons, to design and build complete plants for the recovery of volatile organic solvents, to offer a standard line of units for the removal of odors from air. The new company is the result of the combination of the activities of the Barnebey-Cheney Engineering Co. and the American Solvent Recovery Corp.

**Imperial Chemical Industries Ltd.** in conjunction with the Visking Corp. of Chicago are proposing to form a joint company in Great Britain to manufacture polythene film. No decision has as yet been reached either on the location of the plant or on the amount of capital involved.

**Flek Corp.**, Los Angeles, to specialize in the molding of Kel-F plastic parts.

**Consolidated Vacuum Corp.** to manufacture high vacuum equipment and complete high vacuum systems as well as the complementary line of valves, gages, pumps and pump oil. A subsidiary of Consolidated Engineering Corp., Pasadena, Calif., the new company was formed after the parent company acquired the vacuum equipment department of Eastman Kodak's Distillation Products Industries of Rochester, N. Y.

**Eastman Chemical Products, Inc.**, Kingsport, Tenn., to market chemical products manufactured by the Tennessee Eastman and Texas Eastman divisions of Eastman Kodak Co.

**Kent-Norlantic Ltd.**, Toronto, to distribute, and later to assemble and manufacture, domestic and industrial water meters, flow meters, flow

measuring tubes for liquids and gases, and instruments and control equipment, similar to those manufactured by the parent company in England, George Kent Ltd.

**Industrial Process Equipment Co.**, St. Louis, to handle sales representation of process equipment manufacturers' products in and around the St. Louis and Kansas City trade areas.

**Attapulgus Minerals & Chemicals Corp.**, to operate the combined business of the former Attapulgus Clay Co. and Minerals Separation North American Corp. Their operations include (1) the mining and manufacture of various fullers earth products used as adsorbents and refining mediums in the petroleum industry and (2) the development and licensing to industrial concerns of patented flotation processes for the beneficiation of industrial minerals, including principally potash, phosphate and taconite (low grade) iron ore.

## NEW LOCATIONS

**Elastomer Chemical Corp.**, Nutley, N. J., has moved to larger premises at 212 Wright St., Newark, N. J.

**Whiting Corp.**, Harvey, Ill., has moved its St. Louis district sales office to 567 North and South Rd., University City, Mo.

## NEW LINES

**American Enka Corp.**—Nylon textile fiber which it will manufacture through a licensing arrangement with Du Pont.

**Pulmosan Safety Equipment Corp.**, Brooklyn, N. Y.—Safety goggles and spectacles meeting strictest safety specifications for a wide range of eye hazards met in industry.

**W. C. Hardesty Co. of Canada Ltd.**—Hydrogenated castor oil available for the first time in Canada. A waxy solid, the product is used in all purpose greases, paper coatings, polishes, electrical insulations.

**NEW  
FORM OF  
SODIUM**

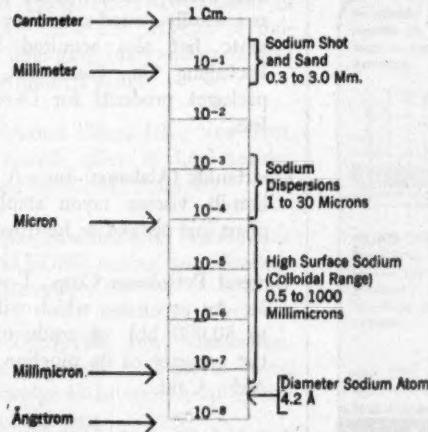
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#### USES FOR HSS

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CHEMICAL ENGINEERING—April 1953

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Using simple, easy-to-follow techniques, our researchers have applied atomic layers of Metallic Sodium to inert solids such as salt, soda ash, carbon, alumina and sand. HSS is free-flowing over a wide temperature range and has a large surface-to-weight ratio of Sodium. Reactions can be carried out in seconds instead of hours. The high surface area of Sodium in HSS, available for immediate reaction, is the key to its importance to industry.

HSS provides, through the complete and rapid reaction of Sodium, the following advantages:

- 1 Easy control of reaction rates and temperatures above and below the melting point of Sodium
- 1 Simple adaptation to continuous operations
- 1 Dry-way reactions of Sodium
- 1 Greater safety by eliminating flammable solvents
- 1 High yields
- 1 Preparation of products in finely divided and reactive states
- 1 Means of avoiding induction periods

#### APPARENT FILM THICKNESS VS. % Na IN HSS

% Na	Film Thickness on Alumina (Area— 160 M <sup>2</sup> /g.)	Film Thickness on Colloidal Carbon (Area— 750 M <sup>2</sup> /g.)
5%	1 Atomic Layer	<1 Atomic Layer
15%	Av. 2.5 Atoms Thick	<1 Atomic Layer
25%	Av. 5 Atoms Thick	Av. 1 Atom Thick

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INDUSTRIAL NOTES, cont. . .

#### NEW FACILITIES

Newark Wire Cloth Co.—The name, plant, inventory, equipment and other assets of the Cosgrove Wire Cloth Co.

California Reduction and Fertilizer Co.—A plant at Emeryville, Calif., to handle byproducts of the meat industry. Donald N. Kessler will head the operation.

Gulf Alkali Corp., New York—Chemical plant, warehouse space, office building and railroad siding formerly occupied by the Chipman Chemical Co. in Houston, Tex.

Koppers Co.'s tar products division—A plant in Fontana, Calif., which is now producing a general line of products made from the crude tar which comes from Kaiser Steel Corp's chemical-recovery coke ovens.

De Laval Steam Turbine Co., Trenton, N. J.—A district office in Minneapolis to handle sales and application engineering in Minnesota, North Dakota and South Dakota.

Monsanto Chemical Co.—All the facilities of Detergents, Inc., Columbus, Ohio, which will be operated as a wholly-owned subsidiary. Monsanto has also acquired Eastern Packaging Co., Columbus, which packages products for Detergents, Inc.

Courtaulds (Alabama) Inc.—A 50-million-lb. viscose rayon staple fiber plant just opened in LeMoyne, Ala.

General Petroleum Corp., Los Angeles—An expansion which will bring to 30,000 bbl. of crude oil daily the capacity of its pipeline at San Ardo, Calif.

Lubrizol Corp.—A \$400,000 additive plant to be built in Niagara Falls, Ont.

W. R. Grace & Co., New York—A DDT and caustic soda-chlorine plant to be built in the Sao Paulo area of Brazil. Actually, the plant will be built by a new company being formed by Grace, American Home Products Corp. and Instituto

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FINISHING  
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- One coat insulates and finishes
- Super-adhesion; no wire mesh
- Least possible shrinkage; no cracks
- Smooth, white, extra-hard finish
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Medicamenta Fontoura, a Brazilian firm.

**American Alcolac Corp.**—Buildings in Baltimore just purchased from U. S. Industrial Chemicals Co. American Alcolac transforms and supplies chemicals to manufacturers of detergents and other household products and to the cosmetic industry.

**Division Lead Co., Chicago**—A plant at Argo, Ill., purchased from the metallic products division of the Eagle-Picher Co. It is scheduled to become a distribution center with portions of the space given over to increased industrial research.

**National Starch Products Inc., New York**—A research laboratory just opened in Plainfield, N. J., the latest step in the company's \$2 million resin expansion program.

**International Paper Co.**—A converting plant in Los Angeles for producing corrugated fiber shipping containers.

**Goodyear Tire and Rubber Co.**—A \$100,000 sales and service facilities building, in San Leandro, Calif.

**American Potash & Chemical Corp.**—A \$300,000 chemical research laboratory just completed at Whittier, Calif.

**Plexolite Corp.**—A \$250,000 plant to be built near Los Angeles to produce fiber glass mats and decorative and structural panels.

**Oliver United Filters Inc., New York**—A branch office in Los Angeles headed by R. M. Stampley.

**F. J. Stokes Machine Co., Philadelphia**—A \$150,000 testing and developing laboratory.

**Arthur D. Little, Inc., Cambridge, Mass.**—Research facilities in West Cambridge to be completed by the end of the year.

**Moore Products Co., Philadelphia**—A branch office in Louisville, Ky., headed by Whitney B. Miller.

**Paisley Products, Inc., Chicago**—The formulas, manufacturing process and equipment of Hayes Adhesives Co., St. Louis, which it has purchased.

(Continued)

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As the largest producer of chlorates and perchlorates WECCO is proud of its record of producing chemicals of unexcelled quality in large scale operation. Check and compare the purity of WECCO'S products and you will find them at the top regardless of whether you sample a cup or a carload.

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Perchlorates  
and  
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**DUST and FUME  
Eliminators**

Available in capacities to handle air cleaning jobs—large or small—singly or in batteries.



30,000 CFM arrester—in a large grey iron foundry removes dirt and dust from shake-out stations, sand handling and conditioning system.

400 CFM to 2500 CFM exhausts dust and fumes from isolated grinding or buffing jacks—self-contained, complete with fan motor and drive.

THE best AIR PURIFY  
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When you have a Schmieq Centri-Merge conditioning unit, designed and engineered for your specific needs, your dust and fume problem is banished once for all. Because Centri-Merge is always dependable, requiring no shutdown during working hours for cleaning or routine maintenance.

Centri-Merge units are used in widely divergent industries, in plants where all kinds of metal working operations are performed, in the chemical industry where purified air is of vital importance.

Centri-Merge operates on a simple principle. It collects pollution in the air, carries it along on a swirling cascade of water to an underwater trap where it is easily disposable as sludge.

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Do something about dust and fumes in your plant. Call in Schmieq engineers to develop a unit ideally suited to your needs. Do it today.

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Engineers & Manufacturers

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#### INDUSTRIAL NOTES, cont. . .

**Conco Chemical Co.**—A branch plant at Shreveport, La., to make soaps, disinfectants and detergents.

**Pan American Sulphur Co.**, Dallas—A \$5 million sulphur processing plant at Jaltipan in southern Veracruz, Mexico.

**Engineering Corp. of America**, Westfield, N. J.—Additional facilities in Garwood, N. J., for fabricating special mechanical and process equipment.

**Babcock & Wilcox Co.**, New York—A \$2 million plant to be built in Wilmington, N. C., for the manufacture of boilers and related equipment.

**West Coast Pipe Line Co.**—A 960-mi. crude oil pipe line from Wink, Tex., to Norwalk, Calif. to have an eventual capacity of 300,000 bbl. per day.

**Cambridge Wire Cloth Co.**, Cambridge, Md.—A branch office in Atlanta, Ga., headed by James M. Evans.

**Foxboro Co.**, Foxboro, Mass.—A branch office at Wichita to serve instrument users in the Kansas area.

**Chemical Development Corp.**, Danvers, Mass.—An office in New York to handle sales of its materials for the plastic and allied industries.

**Viking Pump Co.**, Cedar Falls, Iowa—A warehouse and repair service operation in Atlanta, Ga., to serve the Southeast.

**Liquefied Petroleum Gas Assn.**, Chicago—A district office at Harrisburg, Pa., to serve the east-central district.

**Dow Chemical Co.**, Midland, Mich.—A plant under construction at Torrance, Calif., for the manufacture of its Styron, a polystyrene plastic.

#### NEW REPRESENTATIVES

**American Lucoflex Inc.**, New York, has appointed Colorvision Plastics Inc., Boston, as a licensed fabricator of its unplasticized hard polyvinyl chloride material. (Continued)





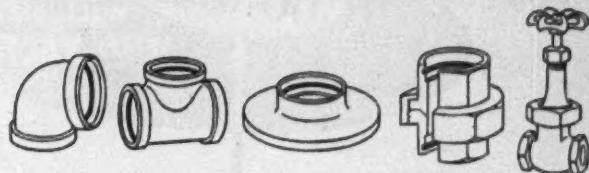
W

# WALSEAL

## COMPLETE LINES OF WALSEAL VALVES AND FITTINGS

WALSEAL is a smooth-bore, bronze valve or pipe fitting having a factory-inserted ring of silver brazing alloy in the outlet or outlets. The brazed joint that results when a Walseal product is installed is leakproof, vibration-proof, and corrosion resistant. The alloy fillet that appears upon completion of the joint is visual assurance of full penetration of alloy. This improved method of joining brass, copper, or copper-nickel pipe or tube is another Walworth contribution to the progress of the valve and fittings industries.

In addition to its complete line of Walseal products, the Walworth Company manufactures complete lines of valves, fittings, unions, and flanges in a wide range of sizes and temperature-pressure ratings. The company also makes three lines of pipe wrenches, the Genuine Stillson, Walco, and Paramelee. Walworth products total approximately 50,000 items and are sold through distributors or agents in all parts of the world.



The sectioned Walseal tee illustrated, shows: (a) the fillet of alloy that appears upon completion of the Walseal joint. This fillet is your visual assurance of complete penetration. (b) the factory-inserted ring of silver brazing alloy. (c) sectioned view of the completed Walseal joint showing penetration of alloy both ways from the insert. Walseal joints can be made only with Walseal valves or fittings. For further details regarding Walseal products, ask for Circular 84.

# WALWORTH

Manufacturers since 1848

valves...fittings...pipe wrenches

60 East 42nd Street, New York 17, N. Y.



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Write for NOZZLE CATALOG to  
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... "the meter that changed chemical processing habits!"

For over a quarter century Bowser Xacto meters have brought to the chemical industry an entirely new way to measure liquids accurately and dependably.

Wherever accurate measurement is essential to assure uniformity of product and control costs . . . there you will usually find Bowser Xacto meters on the job.

Today XACTO meters are handling these and 638 other liquids . . .

Acetic Anhydride	Amyl Acetate	Carboxylic Acid	Iso-Propyl Acetate
Alum Solution	Anhydrous Ammonia	Cellulosic Acetate	Lactic Acid
Ammonium Chloride	Aqueous Ammonia	Copper Nitrate	Naphthenic Acid
Ammonium Nitrate	Arsenic Acid	Copper Sulphate	Resin Alkyd
Ammonium Phosphate	Butyl Acetate	Cresol	Stearic Acid
Ammonium Sulphate	Calcium Bisulphite	Cresylic Acid	Tannic Acid

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#### INDUSTRIAL NOTES, cont. . .

**Farr Co.** of Los Angeles, manufacturers of air filtration equipment, has named three new representatives: Johnson Filter Sales Co., Cleveland; Pittsburgh Air Filter Service Co., Pittsburgh; Air Filter Sales & Service, Detroit.

**Sugar Research Foundation**, New York, has appointed Herstein Laboratories, New York, to act as a screening laboratory for certain projected studies of the foundation.

**Orr & Sembower, Inc.**, Reading, Pa., manufacturers of packaged automatic boilers, has appointed the Combustion Equipment Co. as its distributor in the Chicago territory.

**Parker Appliance Co.**, Cleveland has appointed Florida Metals, Inc., Jacksonville, Fla., as a distributor of its industrial tube fittings and tube fabricating tools.

**B. Braun**, Melsungen, Germany, one of Europe's foremost producers of specialized laboratory instruments, has appointed Bronwill Scientific, Inc., New York, as exclusive U. S. agent and distributor.

**Pennsylvania Crusher Co.**, Philadelphia, has appointed the following representatives: Mine and Smelter Supply Co. of Denver, Colo., and El Paso, Tex.; Alliger and Sears Co., Houston; Tampa Armature Works, Inc., Tampa, Fla.

**Rust-Oleum Corp.**, Evanston, Ill., has appointed the Industrial and Farm Equipment Corp., Chester, Pa., to distribute its complete line of farm and industrial protective coatings.

**Hammel-Dahl Co.**, Providence, R. I., manufacturer of automatic control equipment, has appointed Control Equipment Co., Atlanta, Ga., as a sales and service representative.

#### NEW NAMES

**Culligan Zeolite Co.**, Northbrook, Ill., has changed its name to Culligan, Inc.

**Lawrence Machine and Pump Corp.**, Lawrence, Mass., has changed its name to Lawrence Pumps Inc.

—End

# NOW



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convenience**

## **WOLVERINE BRINGS YOU "U-BEND" CONDENSER TUBES PACKAGED IN EXPENDABLE PALLETS . . .**

The use of "U-Bend" — plain or finned — tube eliminates one tube sheet, rolling-in operations are reduced by one-half and floating head problems are eliminated.

This form of packaging saves you much time. Often a whole complement of tubes for condenser installation can be shipped in one pallet. All the tubes can be fed directly from the pallet type container into the condenser unit or the heat exchanger. Tube unloading,

inspection, installation and handling costs are thus materially reduced.

Each pallet is designed and constructed to suit individual customer's needs and to withstand the abuses encountered in transit.

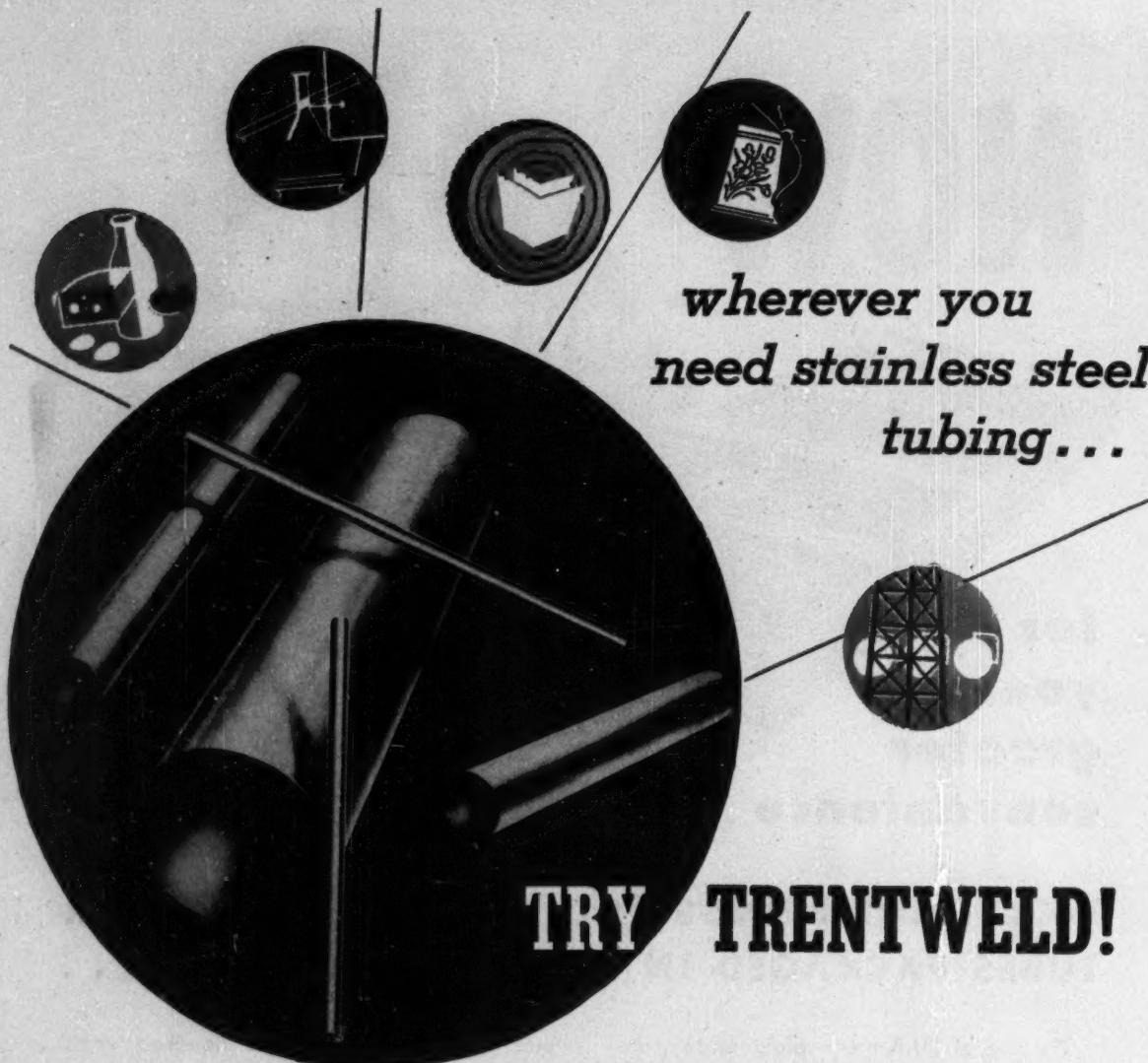
You'll save considerable time by keeping these unit pallets at hand as stand-bys. In this condensed package they occupy comparatively small storage space and can easily be stacked.

**WOLVERINE TUBE DIVISION**  
of CALUMET & HECLA, INC.

Manufacturers of Tubing Exclusively  
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Plants in Detroit, Mich. & Decatur, Ala. Sales offices in Principal Cities





*wherever you  
need stainless steel  
tubing...*

## TRY TRENTWELD!

● Stock lines in food, paper, and chemical plants; heat exchanger units in processing industries; cooling coils in breweries, beverage industry, dairies and dairy equipment... throughout all industry, wherever there's a stainless or high alloy tubing application, there you'll find TRENTWELD.

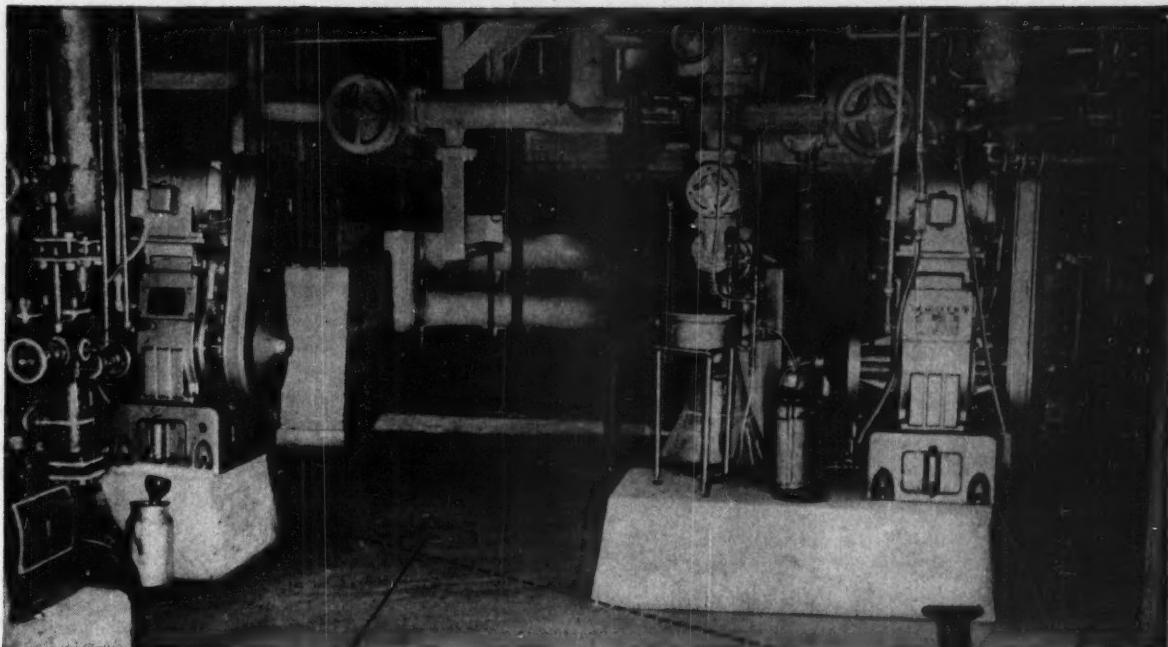
And it's to be expected! TRENTWELD is made in a tube mill by tube engineers who roll and weld stainless and high alloy tubing exclusively. Then too, TRENTWELD is available in a full range of sizes —  $\frac{1}{8}$ " to 40" in diameter. This, coupled with Trent's convenient mid-continent location, means prompt delivery of what you want ... when you want it. If yours is a stainless or high alloy tubing requirement: Call on us.

# TRENTWELD

## STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN

(Subsidiary of Crucible Steel Company of America)



Stokes Microvac Pumps in machine room of Research Laboratories, Inc., St. Joseph, Mo., including diffusion type booster pump, condenser, and oil clarifier. Note relatively small size of the Stokes 8" Vacuum Valve (top-center) compared with other 6" vacuum valves at right and left.

## *Stokes Microvac Pumps . . .*

### *basic to Vacuum Processing*

High volumetric and mechanical efficiency makes these famous pumps economical and reliable units in any vacuum system.

Capacities of Stokes Microvac Pumps run from 15 to 500 cfm . . . pressures to 10 microns absolute. Power consumption is low and the top-mounted motor contributes to compact design requiring minimum floor space.

Lubrication of the four moving parts (including the exhaust valve of corrosion-resistant Teflon) is fully automatic. There are no stuffing-boxes or grease-fittings, and no packing.

Parts are precision-finished, standard and interchangeable. Freedom from wear assures years of trouble-proof service.

Stokes is the only manufacturer of equipment for complete vacuum systems, including Microvac mechanical pumps, oil diffusion pumps, McLeod Gages and Vacuum Valves.

Consult with Stokes on the application of vacuum to drying, freeze-drying, impregnating, extraction, solvent recovery, evaporating, vacuum metallizing, and to other purposes for which vacuum deserves exploration.

F. J. STOKES MACHINE COMPANY, PHILADELPHIA 20, PA.

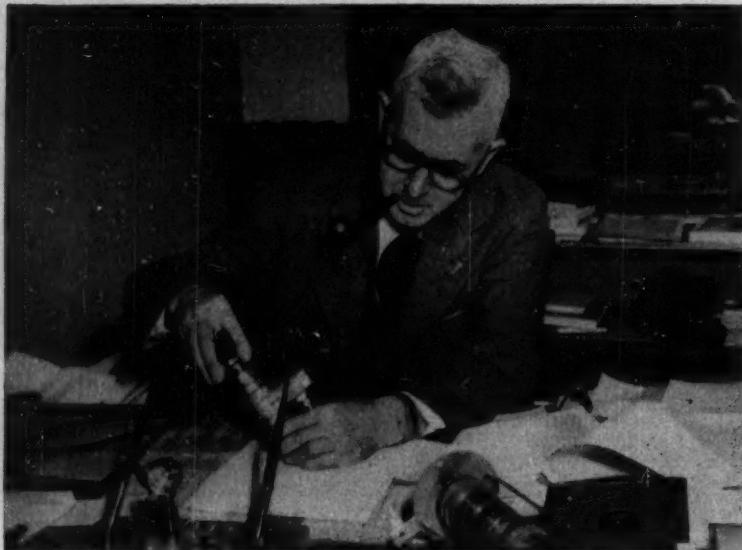
Send for new Vacuum Calculator for rapid slide-rule calculations. Includes standard ABCD log scale. Also send for Catalog 700, "Stokes Microvac Pumps for High Vacuum," with copious reference material.

**STOKES**

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment

## Quotes, Extracts and Digests

Edited by A. J. O'Brien, Jr.



"With the proper support and tools, any good corrosion engineer should . . .



. . . effect savings that'll amount to ten times his salary every year."

### Practical Corrosion Control

To diagnose a failure, an engineer has to be familiar with the types of corrosion and the many corrosion processes. He should know how to use laboratory tools to study corrosion products. That would include metallurgical examination and chemical analysis. He needn't make these tests

himself, but he should know how to interpret them.

► **What He Should Know**—He may often have to develop data on his own. If he is going to be successful, he will have to know the special advantages and disadvantages of the various types of tests. In particular, he should appre-

**NOTE**—Costly construction failures should be as rare as catastrophic failures in structural engineering, explained Corrosion-Engineer F. L. LaQue, International Nickel Co., Inc., at the recent Corrosion & Alloys Forum in Cleveland.

To control corrosion, an engineer has to know his materials, know how to look for trouble, be able to set up standards and get in the habit of keeping records on all major items subject to corrosive attack. LaQue's paper is the basis of this QED feature.—EDITOR.

ciate their limitations and the many pitfalls that these present.

Besides a knowledge of materials of construction, this engineer should know where to find information when he needs it. He certainly doesn't need to keep all his information in his head. But he should know where to get it—whether it be in the literature or someone else's head.

He should know a good deal about the corrosive characteristics of the chemical or chemicals involved in his operations. He should know how they are affected by concentration, temperature, velocity, aeration or the presence of oxidizing or reducing substances or special contaminants.

Physical and mechanical properties are just as important. Any design must be strong enough to sustain potential mechanical stresses. Where high rates of heat transfer are required, thermal conductivity may be important. Possibly, thermal expansion should permit association with some other material without intolerable distortion or the development of excessive thermal stresses.

► **Costs Big Factor**—Above all, he should know costs. Many materials are just too expensive even to be considered for a particular job, even though they may be resistant and mechanically sound.

Silver, for example, might be a little better than nickel for tubes in an evaporator concentrating caustic soda to 50 percent. But cost-wise, its choice cannot be justified. Steel, to take another example, is the economically practical material for tank cars shipping concentrated sulphuric acid

# **FLOWLINE**

TRADE MARK

## **WELDING FITTINGS**

**Stainless Steels, Monel, Nickel**

**3000 Stock Items Made by Corrosion-Resistant Specialists**

Welding Fittings are made throughout the country by

LINE Welding Fittings are lighter schedules for the same service. The system requires less material, and can be assembled and put

**3000 Stock Items**

**FLOWLINE Welding Fittings** are handled throughout the country by leading distributors who sell every-  
thing for corrosion-resistant piping — fittings, valves, pipe, and accessories. This phase of our specialization in corrosion-resistant fittings helps users obtain "on-the-job" service and take fullest advantage of the economy and efficiency of simplified welded construction.

Any corrosion-resistant piping system can be constructed with FLOWLINE Fittings simply by plain butt welding them to straight cut pipe of desired lengths. Initial cost is usually less than that of any other system — welded fabrication with FLOW-

**WELDING F**

**LINE Welding Fittings** permits use of lighter schedules for the same service. The system requires less material, is lighter, can be assembled and put into service faster.

**FLOWLINE** corrosion-resistant fittings include tees, stub ends, ell, reducers, and caps. All are made of close-grained forged or wrought metals, cold formed by our exclusive process and annealed, which consistently puts the metal in the best condition for corrosion service. These fittings are normally stocked at these strategic points in Schedules 10, 40, and 80 (Schedule 5 also available) — sizes  $\frac{1}{2}$ " through 12" — in stainless steel Types 304, 316, 347; Monel; Nickel.

**WELDING FITTINGS CORP.**  
NEW CASTLE, PENNSYLVANIA  
Manufacturers of Stainless Welding Fittings

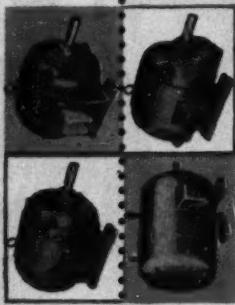
**WELDING FITTINGS**  
NEW CASTLE, PENNSYLVANIA  
World's Largest Manufacturer of Stainless Welding Fittings

**ELECTRO DYNAMIC**  
*Xtra*

# ELECTRO DYNAMIC

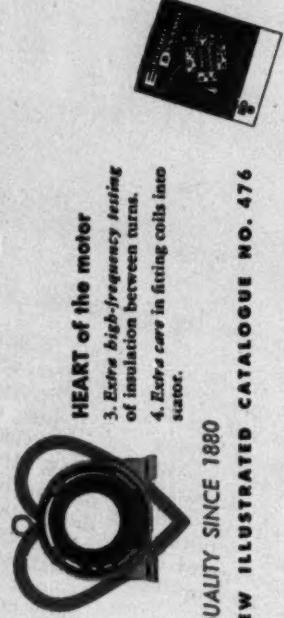
*Dependable industrial motors.*

1 TO 250 HORSEPOWER (N.E.L.A. STANDARDS)



One-piece  
cast iron  
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aligned cast  
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QED, cont. . .

though there are many strong alloys that corrode much less than steel.

Lastly, he should know fabrication techniques—the common practices used to work metals. He should know which material is amenable to what fabrication procedure.

"There is no use in choosing a metal that cannot be welded for a vessel that cannot be fabricated in any other way, nor in specifying an alloy that can be machined only with difficulty for some complicated part that must be finished to close tolerances and be capable of being turned out in quantity on automatic machines at reasonable cost," says LaQue.

► **Look for Trouble**—Frequently, corrosion can be detected before it has become serious and steps then taken to arrest it. Plans may have to be changed or service conditions altered. The sensible engineer stays ahead of his troubles. His responsibility commences the day corrosion commences—not when serious conditions show up.

Usually a person has a choice of many, perhaps too many, ways to handle his problem. He can change the material being used, fabricate it in a different way, apply cathodic protection, eliminate some corrosive contaminant, add an inhibitor, alter temperatures or velocities or aeration. Correct procedure is to consider all possibilities and select the best method on the basis of reliability, applicability, cost and expediency.

How can the corrosion engineer show a profit? Besides a basic knowledge of materials and empirical methods, an engineer should be acquainted with the current good practices being carried out in industry. Thus he will probably cut costs if he learns to . . .

1. Guide the maintenance department in making repairs, particularly those that require the substitution of some new material, the remaking of a defective weld or other joint, the application of a patch or reinforcement of some sort, or the carrying out of heat treatment. At times, the engineer may recommend some change in the process setup, such as an increase or decrease of temperature or velocity. He may be able to recommend the elimination of aeration or an increase in it, or the addition of some corrosion inhibiting compound.

2. Inspect materials prior to fabrication, or fabricated equipment be-

**ELECTRO DYNAMIC**  
DIVISION OF GENERAL DYNAMICS CORPORATION  
BAYONNE, NEW JERSEY

# • Davison Bulletin •

## Check for application AVAILABLE FOR THE FIRST TIME Organic Silicofluorides

Davison's Research and Development Department has devised a method of commercially producing a series of silicofluorides which have previously been known only as laboratory curiosities. Now available:

Methylamine Silicofluoride ( $C_2H_5N\cdot SiF_4$ )  
Diethylamine Silicofluoride ( $C_4H_{10}N\cdot SiF_4$ )  
Ethylhexylamine Silicofluoride ( $C_{12}H_{22}N\cdot SiF_4$ )  
Aniline Silicofluoride ( $C_6H_5N\cdot SiF_4$ )  
Rosin Amine Silicofluoride ( $C_{18}H_{20}N\cdot SiF_4$ )  
Morpholine Silicofluoride ( $C_5H_{11}N\cdot O\cdot SiF_4$ )

Preliminary use research has led Davison's technical representatives to believe that there are many varied applications for these products.

The properties of the materials vary widely. The molecular weight is from 206 to 719; fluorine content 18.2% to 55.17%; and pH in 5% water solution, 2.8 to 4.2.

For full chemical and physical properties write for Product Data Sheet on Davison's Organic Silicofluorides, today.

### Anti-Blocking Agent

Davison now has available a series of high quality, uniform fine sized silicas. The amorphous form of silica possesses unique characteristics when compared to crystalline silicas, e.g. sand. Silica gel, a highly porous form of amorphous silica, characteristically has a large pore volume and surface area. For example, when divided into fine particles less than 20 microns, the porous high surface area characteristics continue to exist, making the product specific for a wide variety of special applications. The product is white in appearance and completely uniform in chemical and physical characteristics.

Commercial forms of silica gel available differ primarily in pore size, surface area, and apparent bulk density. These differences, in addition to the variations produced by surface treatments and particle sizing, have resulted in a series of finely divided silicas adaptable to diversified uses. Many of these grades are now available for anti-blocking and forming plastic sheeting.

Mail coupon for complete information, chemical and physical characteristics, and suggested applications, or contact your Davison Field Service Engineer.

### FREE Literature Available On Method Of Determining Fluid Catalyst Particle Size

An analytical method for ascertaining the size distribution of either a fresh or used catalyst developed specifically to serve requirements of the industry.  
For your free copy, use the coupon.

Progress Through Chemistry  
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Producers of:  
Catalysts, Inorganic Acids, Superphosphates, Phosphate Rock, Silicon Gels, and Silicofluorides. Sole Producers of Devco Granulated Fertilizers.

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- Organic Silicofluorides
- Fine Sized Silicas
- Method of Determining Fluid Catalyst Particle Size

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# NEW 1953

## TEFLON<sup>\*</sup> PACKINGS

BRAIDED TYPE



Chemical plants large and small have long been looking for a permanent acid packing for those "hard-to-get-at" valves.

These valve stems must be packed and made tight at all times. A drip from a leaky valve is dangerous to personnel. These acid valves require  $\frac{1}{8}$ ",  $\frac{1}{4}$ ",  $\frac{1}{2}$ ",  $\frac{3}{8}$ " or  $\frac{5}{8}$ " square packing. Up to now braided blue asbestos packing has been considered best and cheapest (60-day life). Today the whole world of packing has been changed by the miracle material "Teflon". Braided Teflon yarn packing is fast replacing all forms of braided packing for acid service because it lasts as long as the valve itself. Practically no acid, diluted or concentrated, hot or cold, has any affect on the packing. (Many records of two-years' service or more have been reported). This is the big news for 1953 for Chemical Engineers and Chemical Plant Operators.

"JOHN CRANE" Style 704 is available in handy coil or spool form in a full range of sizes. A stock of "JOHN CRANE" Braided Teflon Packing in your storeroom may be a life saver for you.

Teflon is recommended on chemicals at any pressure with temperatures ranging from -100°F. to +500°F.

Many Chemical Engineers prefer "JOHN CRANE" Style 704 Braided Teflon Packings for their service. For the best in mechanical packings fabricated from braided Teflon, contact Crane Packing Company. Send for this Teflon Technical Bulletin. Write 1809 Belle Plaine Ave., Chicago 13, Illinois.



\*Du Pont's trademark for tetrafluoroethylene resin.

CRANE PACKING COMPANY

QED, cont. . .

fore delivery. The corrosion engineer should make sure there are no defects or departures from specification.

3. Schedule maintenance measures. Object here is to deal with serious corrosion before it occurs or before it reaches an advanced stage.

4. Maintain records of experience with equipment subject to corrosion. Log sheets or ledgers should describe the materials and fabrication procedure for the initial installation, the occurrence of any significant corrosion and what steps were taken to remedy the situation.

5. Set up standards. Often it is possible to cut costs by cutting down on spare equipment, parts and materials kept on hand for emergencies due to corrosion failures. Thus more or less standard valves and pumps may often be used in several processes. Same applies to pipe, packing, gaskets and other incidental items. Heat exchangers may be designed to use tubes of a few standard diameters, gages and lengths.

6. Study flow sheets and process details from the corrosion point of view. "It is often possible to suggest changes that will prolong the life of the materials in use or permit the use of cheaper materials," says LaQue.

"Along with this is the opportunity to improve the product by eliminating or reducing the pickup of corrosion products that may be detrimental to quality. . . Given the required support and tools to work with, any good corrosion engineer should be able to effect savings that will amount to at least ten times his salary each year."

### SUGGESTION

#### . . . High-Pressure Trouble

By selecting the right packing, by choosing the right material of construction and by using separators properly, you can stop many troublesome operating problems in high pressure systems. Chemical engineers A. V. Slack, H. Y. Allgood and H. E. Maune of the Tennessee Valley Authority arrived at these rules as a result of successful experiments with TVA's ammonia converter at Wilson Dam, Ala. The three men discussed their problems with the converter at the recent annual meeting of the AIChE in Cleveland.

At Wilson Dam, TVA operates a modified Haber-Bosch process. Synthesis gas, produced from natural gas, passes through a six-stage fresh-feed compressor and is scrubbed with water and an ammoniacal solution of copper salts. The purified gas then enters the synthesis units at about 4,450 psi.

At high pressures, moving equipment parts usually give the most trouble. TVA engineers particularly had pains with valve springs and plates, where most difficulty was caused by entrained water in the synthesis gas.

To overcome the difficulty, they installed separators after each compressor intercooler, even though the intercoolers were designed to catch and drain the moisture themselves. Separators were also placed on the feed line to the compressors to remove water droplets as well as scale and other contaminants.

As a result, valves in lower pressure stages now last as long as four years. In the higher stages, however, valve breakage still remains the most frequent cause of compressor downtime. One consolation though: by close co-operation between shop and maintenance personnel, valve changes can be made in as little as five minutes.

Other changes have been made. Teflon V-ring packing has replaced the diamond-cut metallic packing, with the result that leakage has been eliminated and the valves move more freely. A 3-in. depth of Teflon packing is sufficient.

In addition, the finned inner tubes in the intercoolers, formerly made of corroding mild steel, are now made of stainless steel. Also, valve and plugs are now made of nitrided steel and are renewable.

These changes have solved many, but not all the problems. Compressor maintenance still is the principal cause of process downtime in the plant. However, they are not important enough to make a spare compressor economical.

#### REPORT

#### *. . . On Atomic Engineering*

"I will attempt to point out to you some of the many reasons why so much effort in the research and development of atomic energy is necessary," said AEC Manager Alfonso Tammaro, Chicago Operations Office, at a recent meeting of the ASME in Chicago.

## Here's why Processing Plants Need—

### DINGS MAGNETIC PROTECTION . . .

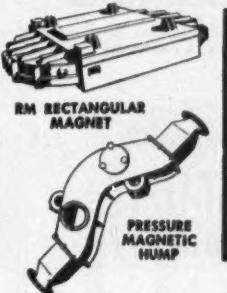
THE junk above is an actual tramp iron accumulation removed by a Dings Magnet installed in a Wisconsin paper mill . . . a rough diet for pumps, screens, grinders and other equipment.

Look at the iron on this Dings Perma-Plate—a powerful non-electric magnet that can be installed in chutes, ducts, or above belts to remove iron from wood chips. Magnetic Permanence guaranteed forever. Engineering data in Catalog C-1205-A, write for it.

Fully automatic iron removal with a Dings Magnetic Pulley—used here as the head pulley on a chip belt. Iron is discharged separately from chips. Dings Pulleys are unbeatable for power, economy. Write for construction details, capacities.

Dings Non-electric Drum-type Separator installed in ductwork carrying chips separates iron automatically. Perma-Drums can be installed almost anywhere in chutes or ducts. Magnetic permanence guaranteed. Details in Catalog C-1100-A.

For removing iron from liquid lines, or chutes either the most powerful rectangular magnet made, Dings RM, or a Magnetic Hump equipped with two Dings Perma-Plates. Write for Bulletin 653, and see your Dings representative whatever your tramp iron problem may be.



**DINGS MAGNETIC SEPARATOR CO.**

4730 W. Electric Ave., Milwaukee 46, Wis.



how to make trace metals  
**TRACTABLE**

...the

# Versenes®

## TRACE METAL TROUBLES

Infinitesimal as they may be, Trace Metals may cause all kinds of costly complications. In industrial processes and products they spoil chemicals, soaps, textiles, dyes, rubber, hides, foodstuffs, metals, plastics, paints, adhesives, drugs, pharmaceuticals, fertilizers, and dozens of other things as well. Recent intensive research on trace metal deficiency in agriculture and medicine now furnishes profound clues to the causes of sickness, health and well-being in living things. Control through chelation is the remedial action indicated.

### VERSENE — POWERFUL CHELATING AGENT

As a powerful chelating agent, it is Versene's job to make trace metals tractable. It keeps them under precise control. Properly used, one or more of the Versenes and the chemistry of chelation can correct excesses or deficiencies of metallic ions. Whenever these trace metal disturbances occur they are ready to rush to your rescue.

### COMPLEXING POWER GUARANTEED UNIFORM

The Versenes are extremely stable at high temperatures throughout the pH range. Made only under processes originated, developed and patented by F. C. Bersworth, uniformity of complexing power is guaranteed in either sample or carload quantities. Write Dept. M. Ask for Technical Bulletin No. 2 and samples. Chemical Counsel available.

VERSENE WATER TEST KIT. Tells total hardness in 2 minutes. Accurate to 1 gr. per gallon. Complete with instructions. \$3.00 postpaid.



*Chemistry's most precise chemicals*  
**BERSWORTH CHEMICAL CO.**

FRAMINGHAM, MASSACHUSETTS



#### WAREHOUSE STOCKS

Providence Agent: George Mann & Co., Inc., 251 Fox Point Boulevard, Providence, R.I.  
W. Coast Agent: Griffin Chemical Co., San Francisco, Los Angeles  
Midwest Agent: Kraft Chemical Co., Inc., 917 W. 18th Street, Chicago  
Western Agent: Wasatch Chemical Co., Salt Lake City, Utah  
Southwest Agents: Berada & Page, Inc., Dallas, Houston, Kansas City, etc.  
Chas. S. Turner Co., 1815 Liberty Life Bldg., Charlotte, North Carolina  
Siegel Chemical Co., Brooklyn, N.Y.

QED, cont. . .

"Harnessing the energy from the atom exposes some strange characteristics and introduces many requirements that are not apparent in conventional fields;—there is one major requirement that is placed on all materials of construction that has heretofore been unknown, and that is, it must not possess the ability to capture neutrons easily.

"Let me explain: A chain reaction is possible because one neutron is required to split an atom and more than one neutron is released in the process. However, neutrons are not only absorbed in uranium to cause fission, but unfortunately they are captured in all materials with which they come in contact. The capability of a material to eat up these neutrons varies in different materials.

"Thus, it is apparent that in constructing a nuclear reactor, materials must be used that have a low adeptness for parasitically absorbing the neutrons in the reactor. In other words, one is not only faced with the conventional problems of choosing materials such as the mechanical and physical properties of thermal conductivity, strength, melting points, etc., but also with the nuclear properties.

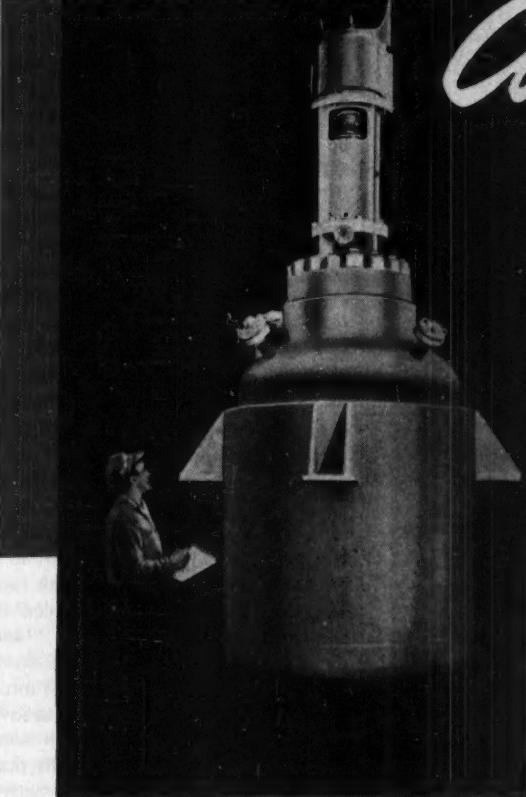
"As fate would have it, it seems that the conventional materials possess undesirable nuclear properties, and it was therefore necessary to find materials of construction that have never before been explored.

"A good example of this is zirconium which possesses good characteristics for use in nuclear reactors because of its low neutron absorption and its good corrosion resistance. Prior to this time the use of zirconium was limited to very few applications such as the manufacture of plates for surgical purposes.

"Moreover, even the normal impurities in material can eat up sufficient quantities of neutrons to hold up a chain reaction. It is therefore necessary to purify such common materials as water and graphite on a large scale. Heretofore methods of achieving such an exceptionally high degree of purity on a production scale were not known.

"It is necessary, then, to go to extremes in exploring new materials and new processes. It is necessary to explore methods of handling ores that have an extremely low metal content. It is necessary to explore the metal-

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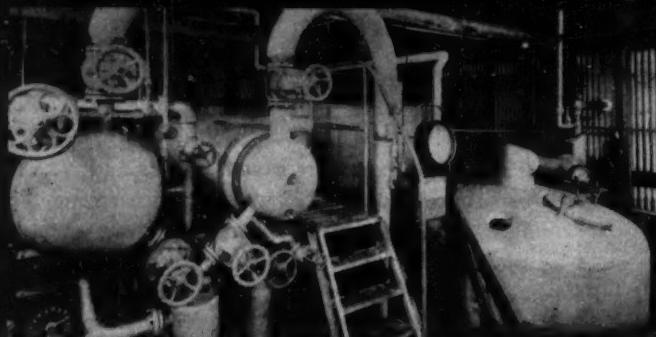
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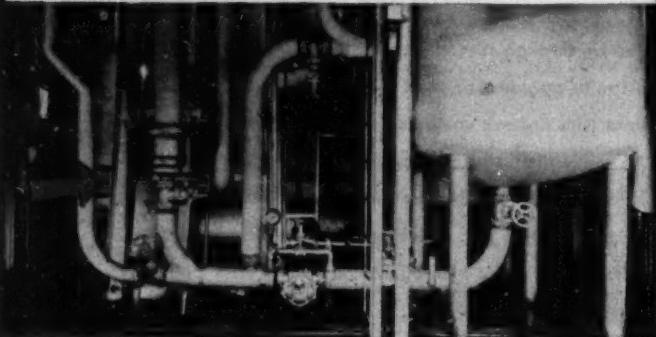
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**QED, cont. . .**

lurgy of new materials that have never been used as structural materials.

"Methods of fabricating them in suitable shapes, or alloying them with suitable materials or of bonding them to make them meet the strange requirements in a nuclear reactor must be found. They also must be made to withstand irradiation damage.

"Moreover, methods of chemically processing these new materials must be explored—separating them from the fission products, cladding, and other materials that have been formed in the reaction. This must be done after they have become deadly radioactive and can only be handled from behind thick shielding walls. Suitable remote control apparatus must be designed to perform these operations.

"Unique control devices must be developed to control the chain reaction. Such devices must always be standing by ready to quench out in a micro-second any possible reactor runaway. Pumps must be developed to handle radioactive solutions, and stand up under the radioactive bombardment and corrosion. Pumps must be developed to handle hot radioactive liquid metals at extremely high temperatures. Seals must be so tight that even minute quantities of radioactive materials or expensive materials such as heavy water do not leak out."

#### FORECAST

##### *. . . Tomorrow's Motors*

Many new and improved motor designs will be available to the process engineer in the near future. According to Frank R. Benedict of Westinghouse, tomorrow's motor will have a drive unlike any made today. As a result, speed, which will be controlled through a frequency changer or rectifier built into the frame, will be able to be varied over a wide range.

This motor will be failure-proof with a switch or starter built into the terminal box. It will have built-in thermal and overload protection, and will require only a foundation, electrical connection and a shaft connection.

Trends right now point to a single, completely enclosed, self-cooled motor that can be used for general applications and can further be used for most of those applications now requiring special enclosures. Electrical manufacturers figure they can turn out more

of these motors and cut down on their engineering and manufacturing man-power at the same time.

**Reduced Size**—Off-setting this trend, however, is the increasing demand to reduce the physical size of motors. Improvements in ventilation coupled with new materials and construction techniques will make possible reduced sizes.

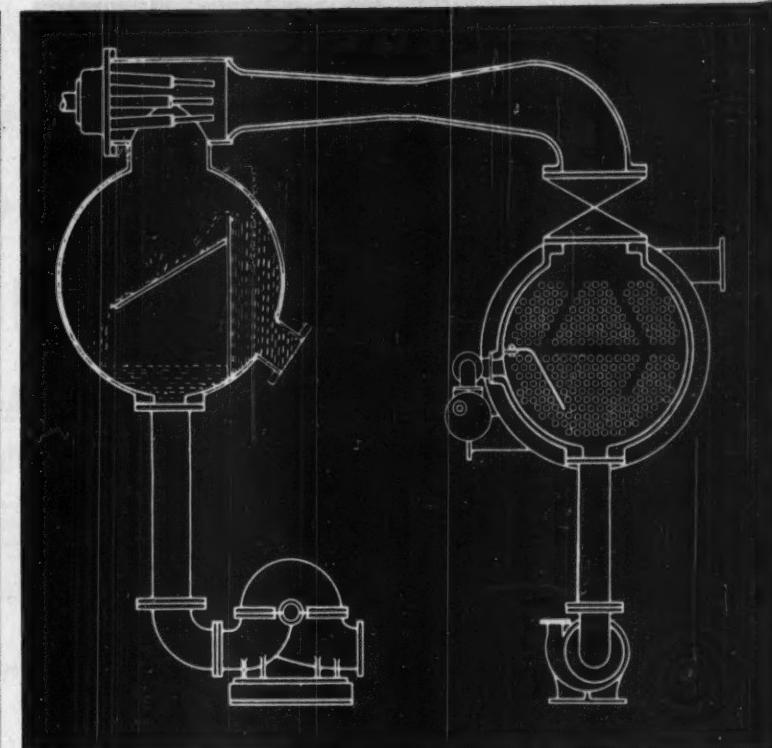
If temperatures are allowed to rise, new silicone insulations would permit a further reduction in size. Electrical manufacturers think they can take care of the higher temperatures. They would first have to develop a stable, high temperature bearing lubricant and then improve electrical sheet steel to better power factor, torque and efficiency. "Research engineers have already made a good start on these problems and there is real hope for early success," says Benedict.

Windings are going to be made with a predictable life. "Our engineers have never been called upon to design for this specific characteristic—obtaining a very low probability of failure over a given time—but it can be done."

New adjustable-speed induction motors may challenge the present position of d-c machines. A superior and compact static or tube-type frequency converter will probably first have to be developed. Tomorrow's d-c single motor drive will probably have the rectifier and control (possibly magnetic amplifier type) built directly into the machine frame so that each unit will be self contained requiring only a-c power for operation.

**Better Control**—With the development of better electron tubes, with longer life, more uniform characteristics, controls are going to be better. Long-lived tubes, which would be important building blocks of control, are badly needed. A motor has an operating life of say 15 years (130,000 hr.); few tubes have a life longer than 10,000. Anyway, trends now point to reduction in tube size along with improvement in performance.

Rectification and amplification have been improved, and even bigger improvements are in sight. In the last few years, great strides have been made in improving the characteristics of copper oxide, selenium and germanium rectifiers. These semi-conductors, however, do not operate satisfactorily at elevated temperatures. The recently announced results, therefore, of investigations on the properties of pure



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3. Will all or any part of the chilled water be recirculated.
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QED, cont...

silicon was a real break in the long-standing temperature barrier.

There is a good possibility of increasing the operating temperature to as high as 200 deg. C. As a result, rectification characteristics may be improved at least one magnitude and possibly two. With such a development, controls will be smaller, lighter and vastly improved in performance.

New developments on silicon transistors show real promise. Besides temperature limitations, present transistors cannot handle high powers. The silicon transistor can—both increased current and increased voltage.

"It is quite unlikely," says Benedict, "that these devices will supplant tubes completely. Rather, this development will spur tube development and will certainly result in higher capacity, longer life and more rugged tubes."

Better devices are being designed for closing and opening circuits under power conditions. "We can look some day to the end of present contactors with their open arcs. The arc flame is a nuisance, is gas producing, and is destructive of material. We will find some way to enclose the arc and snuff it out in a high dielectric gas or possibly a vacuum.

"Motor and control designers look forward hopefully to the day when they can offer to industry not just control elements, protective devices, and a means for converting electrical to mechanical energy, but an integrated drive, compact, fool-proof, self-protecting, maintenance-free. They are mindful that the day is coming when a process shutdown, with its enormous cost, must not be chargeable to the motor and its control."

### DISCOVERY

#### ... Hydrogasification

The Institute of Gas Technology, which is doing development work on natural gas substitutes, has found a way to reduce tar formation during thermal cracking processes. Called hydrogasification, the new method adds hydrogen to the feed going into the thermal cracking process.

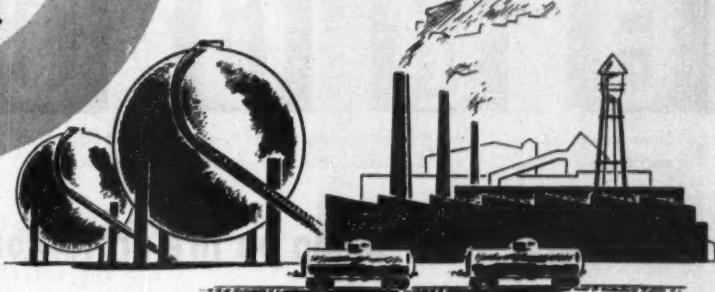
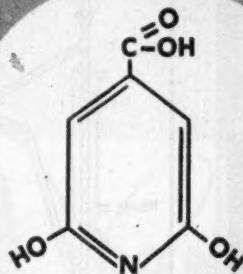
During their studies of possible oils for high Btu. gas production, engineers at the Institute first discovered that the carbon-hydrogen weight ratio of an oil determines, upon thermal cracking, the gas and tar distribution.

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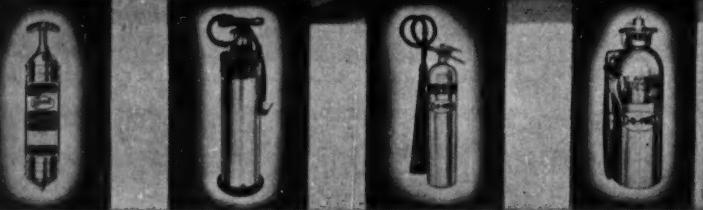
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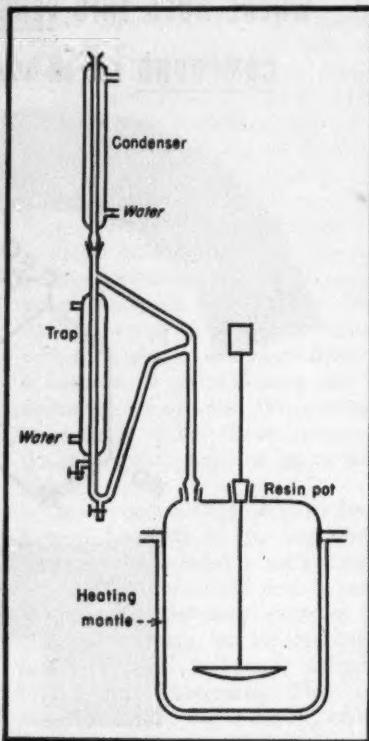
**Portable fire extinguishers:** vaporizing liquid, soda-acid, foam, cartridge-operated, carbon dioxide, dry chemical, and pump tanks • **Wheeled extinguishers:** soda-acid, foam, carbon dioxide, dry chemical types • **Air foam play pipes:** Systems for special hazards



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Thus, oils with a higher C/H ratio produce the smaller volumes of gas and the larger volumes of tar.

Hydrogasification naturally is more effective with low molecular weight products. With propane, for example, recovery is 99 percent and the hydrogen-kissed product is completely interchangeable with natural gas. With heavy Bunker C oils, tar formation can be substantially reduced, but not eliminated.



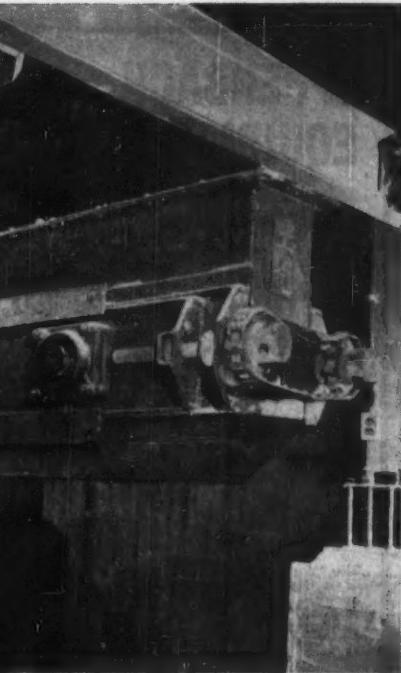
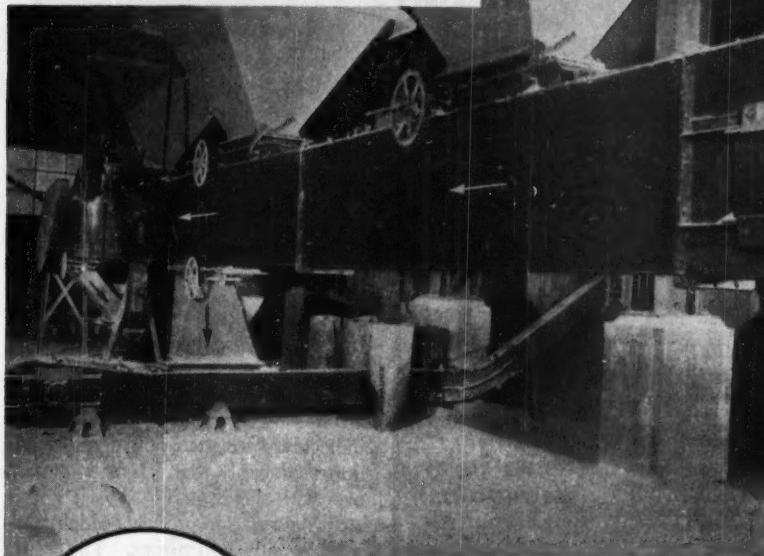
### DEVELOPMENT

#### . . . New Resin Process

Erik R. Nielsen, Armour Research Foundation, has developed a new process for making furfuryl alcohol resin intermediates. In conventional processes, an acidic catalyst is used to form the resin intermediate. In the new process, the resin is formed by heating the furfuryl alcohol in the presence of a special type of activated alumina catalyst. Resinification, as a result, takes place quickly and smoothly.

Contrary to intermediates turned out by the conventional processes, Nielsen claims that his product has a long shelf life, practically unlimited. In addition, with the new process,

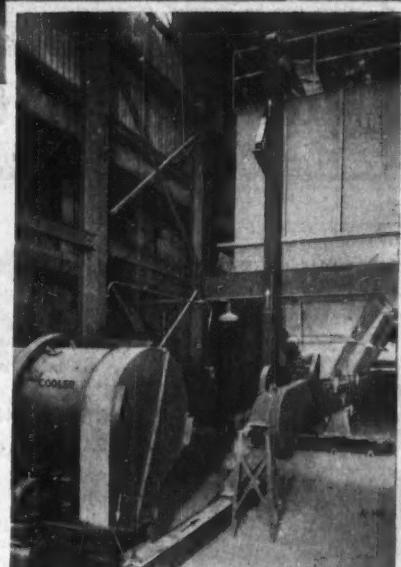
This complete S-A System includes numerous REDLER Conveyors and Elevators, engineered for coordinated handling. The System feeds the grinding mill, carries ground pigment to storage bins, and from the bins to packaging. It also takes pigment from rotary kilns, via cooler units to intermediate storage, and recovers the granulated pigment from storage (see large photo). S-A Bin Dischargers are used to speed up the withdrawal of pigment from storage.



move paint pigments without  
contamination or spillage . . .

The problem here was to provide a system to move bulk paint pigment through processing, storage and packaging. Contamination or escape of pigment could not be tolerated and low handling costs were, of course, a prime requirement.

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Z-type REDLER runs from cooler at left to storage bins. It also takes excess pigment from reclaiming conveyor under bins.

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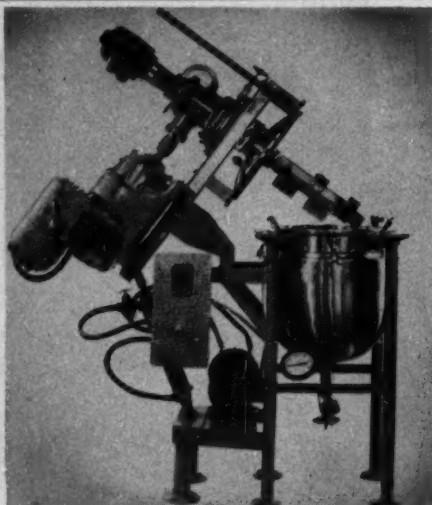
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QED, cont. . .

modifying agents may be added to the resinification reaction at any desired point. Compression molding compounds based on furfuryl alcohol resins consequently can now be produced more practically.

**How it Works**—In a typical experiment conducted by Nielsen, 650 g. technical furfuryl alcohol and 65 g. 8-14 mesh activated alumina composed mostly of gamma alumina was boiled in the resin pot shown above, with slow agitation.

In the process, furfuryl alcohol vapors escape, are condensed and returned to the resin pot via the trap. In about 20 min., liquid collecting in the trap becomes cloudy and shortly thereafter two liquid layers form in the trap. The top layer is substantially water and the bottom layer furfuryl alcohol with a small amount of low molecular weight polymer, mostly dimer probably that has been carried over with the alcohol.

Initial reaction product, which is insoluble in water, forms. The water separates out, collects in the trap and is removed as needed through the valve on the side near the bottom of the trap.

At the end of a run, the furfuryl alcohol is collected in the trap and removed through the bottom valve. The trap is kept cool because hot condensed furfuryl alcohol will cause the condensed water to boil intermittently, and with almost explosive violence.

During one experiment after a run of 1.75 hr., 99 g. split out in the reaction and 61 g. unreacted furfuryl alcohol was recovered in the trap. The slightly viscous hot resin intermediate was poured through a screen to remove the catalyst. It became semi-solid upon cooling. The polymer then probably had an average of 12 furan units to the chain.

In this experiment, 10 percent catalyst was used. However, less could be used. Thus with 5 percent of the 8-14 mesh catalyst, the same result is obtained, but at a slower rate. But the reaction is not speeded up significantly when more than 10 percent is used. A fluid type catalyst may be used, but again the reaction rate is slower.

**Economic Argument**—Nielsen claims his gamma alumina process is more economical. "In the conventional process of producing furfuryl alcohol resin intermediate," he explains, "a

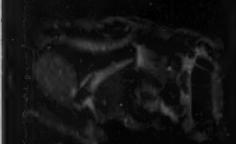


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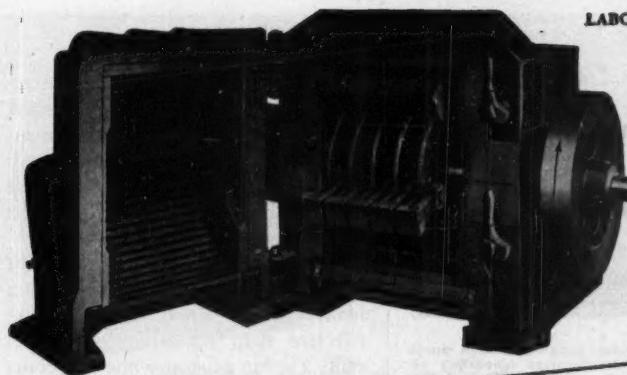
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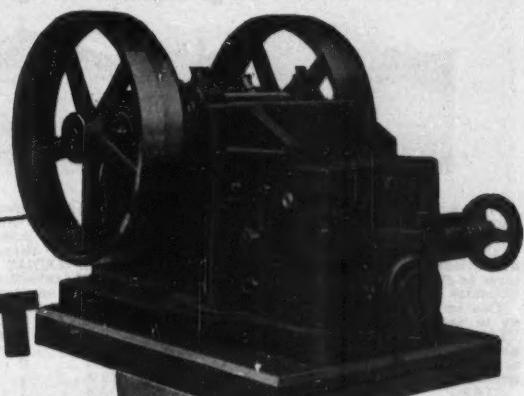
The Waukesha P.D.\* Pump features: One-Piece O-Ring Sanitary Seal — Compact streamlined construction of Corrosion-Resistant "Waukesha Metal" or Stainless Steel on all product-contact parts — Heavy Duty Ball Bearings — Faster cleaning and sanitation — and other advantages.

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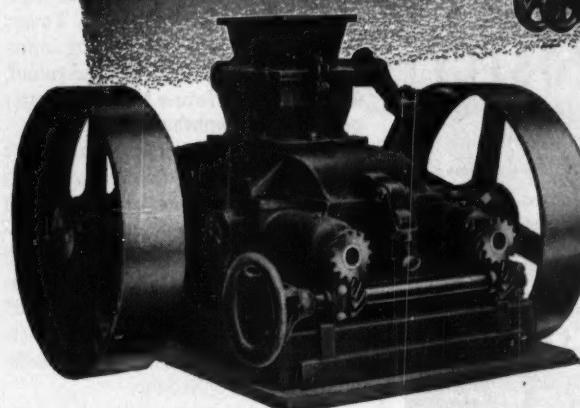
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12.2 1/2 - 1	TiO <sub>2</sub> 1.65%
12.6 1 - 2	Fe <sub>2</sub> O <sub>3</sub> 0.57%
14.2 2 - 5	CaO 0.00%
6.9 5 - 10	MgO 0.00%
10.5 10 - plus	Na <sub>2</sub> O, K <sub>2</sub> O 0.00%

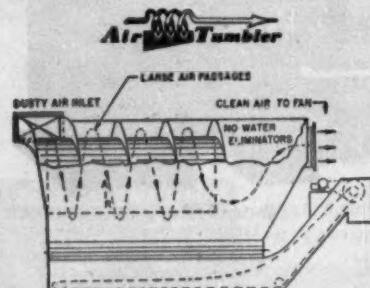
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QED, cont...

solvent is added to moderate the reaction, the intermediate formed must be washed and (or) neutralized to inactivate the acidic catalyst employed, and finally the intermediate must be dried. All these steps are eliminated in the new alumina process."

Conventional processors do not agree with Nielsen. They say that a neutral catalyst is not that much more effective than acidic catalysts, especially a rather expensive one as gamma alumina. Commercially, the process would be carried out in much the same way as it is right now. In addition, they claim the explosion hazard is magnified unduly.

## OPINION

### ... Coal Chemicals Wanted

What kind of market do we have for so-called coal chemicals? On the supply side of the picture, the coal tar and light oil industries have been expanding at the rate of 2 to 3 percent per year, pretty much paralleling the steel industry. However, there is no long-term prospect of rapidly increasing supplies from this source.

From petroleum sources though, long-term prospects look good. Today, the petroleum industry is adding appreciably to supplies of benzol and tuluol, and may in the future turn out greater quantities of naphthalene.

On the demand side, expansion is rapid. For example, polystyrene resins and styrene uses for synthetic rubber will require greater quantities of benzol. Synthetic detergents use, which has been increasing the last few years at the rate of 30 percent per year, will also boost benzol or phenol demands. This use also consumes smaller amounts of naphthalene.

Growth in resins has also been rapid: 35 percent per year for polystyrenes and 14 percent per year for phenolic resins. Alkyd resins and plasticizers for coatings represented by demand for phthalic anhydride have been growing at a rate of 15 percent per year.

"In a long-range view, demand for aromatic chemicals has outstripped the foreseeable supply from the coke oven," says Vice President Harry B. McClure, Carbide and Carbon. With over \$11 million invested in a new coal-hydrogenation pilot plant, Carbide has an obvious interest in the



Just a flick of a switch, then read the Brookfield dial, and you have your viscosity determination in centipoises. The whole operation, including cleaning up, takes only a minute or two.

Available in a variety of models suitable for extremely accurate work with both Newtonian and non-Newtonian materials, Brookfield Viscometers are portable and plug in any A.C. outlet. Write today.

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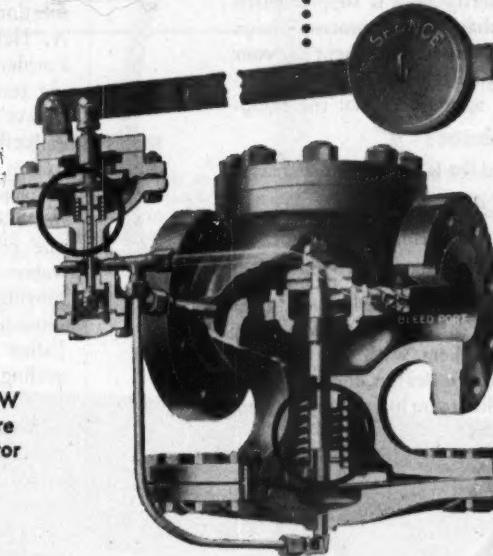
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**FOR LONGER LIFE**

Type EW  
Pressure  
Regulator



*A few  
other design  
features:*

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**SPENCE ENGINEERING  
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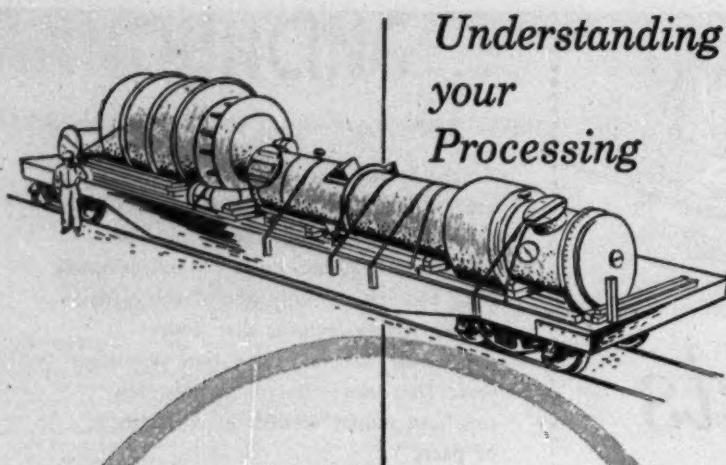
In the Spence Regulator, the springs are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life. This is only one of the many Spence design features that assure dependable, accurate regulation year after year. That means less down-time, less time and money wasted on replacement of parts.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure, Back Pressure, Pump Governor and many other types. Write for bulletin 100 giving full details.

**SECO METAL SEATS AND DISCS—**  
Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

**LARGE BALANCED METAL DIAPHRAGM**  
located in a cooled zone with a condensate seal above and below it, never has to be replaced under normal conditions.

**PACKLESS CONSTRUCTION**—All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . reduces valve stem wear and eliminates time-consuming maintenance.



## *Understanding your Processing*

*...we start with that*

Yes, we start with a full understanding of your processing requirements. This understanding is supplemented by our experiences in mechanical and process design which enables us to provide the best equipment for your particular problem. Our engineers certainly know processing, and knowing it can appreciate what the equipment is expected to do.

Included in a long and varied list is equipment such as —

Process Units

Special Coils

Distillation Columns

Extraction Equipment

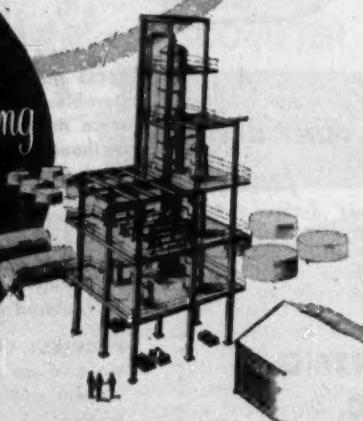
Pressure Vessels

Heat Exchange Units

Our shop men are skilled in fabricating all kinds of materials to close tolerances. They, too, have many years of experience back of them. With this two-fold service available — experience design engineers and skilled shop craftsmen, wouldn't you like to have us work on your equipment problems?

*Engineering and  
Manufacturing*

Process Equipment  
of Our Design  
to Solve Your Problem



**BADGER MANUFACTURING COMPANY**

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QED, cont. . .

future market of chicken wire chemicals.

According to McClure, the company's crystal ball divines huge markets for new end uses. On the near horizon are blowing agents for plastics. Structural materials that require aromatic chemicals are coming. In clothing, for example, aromatic chemicals are becoming more important in the new textile fibers. Besides these, Carbide's application research, that of the coke-oven industry, and its customers, McClure says, will develop new uses.

### REPORT

#### *. . . Adsorption Techniques*

In adsorption operations, what is the most effective way of treating a solution with activated charcoal? W. A. Helbig and C. J. Ballos, Atlas Powder Co., who have been conducting tests with activated charcoal and brewer's wort, recently reported several effective methods for treating a solution with activated carbon.

In one investigation, a slurry was made with warm water in the ratio of one pound of carbon per gallon of water. Enough slurry was made to provide six pounds of carbon for each hundred barrels of wort to be treated. Either mechanical agitation or recycling through a pump may be used to uniformly suspend the slurry.

After full boiling began and the hot break begins to form, slurry was added to the brewing kettle. The slurry may be dumped directly into the kettle with pails, piped directly to the kettle, or sent to the kettle via a grant. The wort is then vigorously boiled to assure thorough mixing.

When the mix cannot be boiled, in cellar treatment operations for example, other methods are possible. For example, the carbon can be put into a storage tank with a small quantity of water or beer. Then the beer to be treated can be pumped into the tank. The turbulence stirs up the slurry at the bottom of the tank. Rousing with carbon dioxide is also effective.

However, here is an even better method: Inject the carbon slurry into the pipeline carrying the beer to a storage tank with a proportioning pump. The slurry injection lines should be short—not over 12-15 in.

# 4

# reasons why Trane dry-type fluid coolers last longer

## 1

### Correct metal selection

A wide variety of types of metals are available for highly corrosive applications. Coils can be supplied in combinations of cupro nickel, admiralty, red brass, copper, aluminum, monel, steel, stainless steel and many other special metals. TRANE engineered products have solved corrosion problems of all types, yet obtained maximum heat transfer and maximum life from the fluid circuit.

## 3

### Extra-rugged construction

Framework of the TRANE Fluid Cooler is so strong it can be used for stationary or portable installation *without additional bracing*. Its simple structural design permits fastest possible erection. Yet it is more than strong enough to support core and accessories and withstand wind and shock load. Finish on the TRANE Fluid Cooler is a rubber-base paint that's completely weatherproof.

## 2

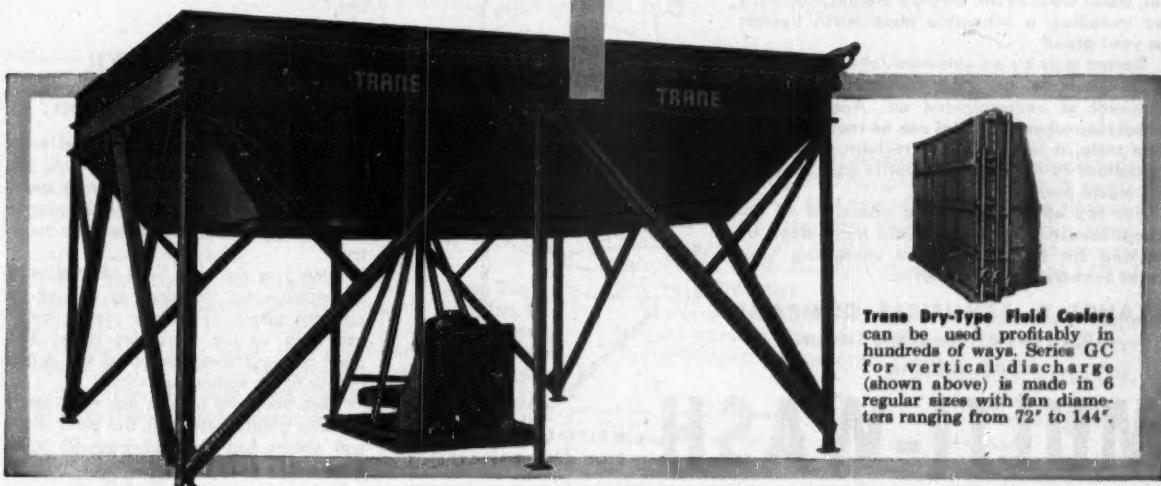
### Permanently bonded fins

In constructing the Extended Surface Coil—heart of the fluid cooler—TRANE bonds fin to tube *mechanically*. This bond is as permanent as the metals that form it and as strong as though fin-and-tube were one. Heavy support plates are used to reinforce and protect the coil and prevent tube sagging. And the exclusive TRANE Guide Flange cradles the coil to permit expansion within casing.

## 4

### Freedom from vibration

TRANE Fluid Coolers run smoothly . . . quietly. They stay sound and tight longer because TRANE engineers have virtually eliminated the causes of vibration. Here's how: The variable-pitch fans are dynamically balanced. Solid, oversized fan shaft is firmly mounted in giant thrust bearings. Drive components are aligned at the factory and shipped assembled. Orifice ring is designed to *match* the fan.



Jacket water cooling costs are cut to the minimum with the TRANE horizontal air stream Fluid Cooler. Series EC—available in 14 sizes with fan diameters from 18" to 120".

Trane Dry-Type Fluid Coolers can be used profitably in hundreds of ways. Series GC for vertical discharge (shown above) is made in 6 regular sizes with fan diameters ranging from 72" to 144".

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of heat exchange*

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CHEMICAL ENGINEERING—April 1953

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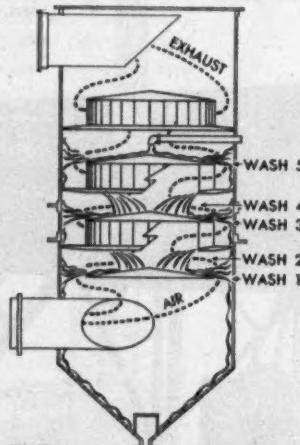
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• Entroiment Separators • Settling and Downtaking Tanks • "Wear Proof" Centrifugal Slurry Pumps



MULTIPLIES WASHING  
FOR TOP EFFICIENCY

QED, cont. . .

When the slurry is put into the line it is stirred up by the turbulent flow of the beer. By the time the large tank receiving the beer is full, the carbon will have done its job. It usually takes 30 min. for the carbon to act. The carbon can then be filtered in an ordinary powder filter. If, through mischance, some carbon gets past the powder filter, it can be removed in a pulp filter.

## DEVELOPMENT

### ... Transferring Heat

The battery of exchangers at New York City's Owl's Head sewage disposal plant picks up heat from engine-jacket water and supplies it to sludge digesters and building space heaters. When heat loads are high, two oil fired boilers heat water to supplement the flow to the exchangers. When the loads are low, engine-jacket water passes through a set of secondary heat exchangers and is cooled by plant effluent.

In the digesters, excess sludge and scum from a settling basin are treated in two stages. Bacteria-containing sludge is recirculated; and supernatant liquid from the second stage is sent back to the plant wetwell for reprocessing.

The Owl's Head plant, which can treat 160 million gallons of sewage a day, is the first installation to use modified aeration treatment of sewage.

## LITTLE BONER

### Lesson From Washington?

A large and well-known chemical company, with head offices in New York, has usually been looked upon as a pretty smart operator—alert and efficient in keeping a finger on its plants throughout the country.

Every year the New York office allowed depreciation for the dock at one of its southern plants. That was proper, for it had been on the books for years. The plant manager always accepted the depreciation figure without question.

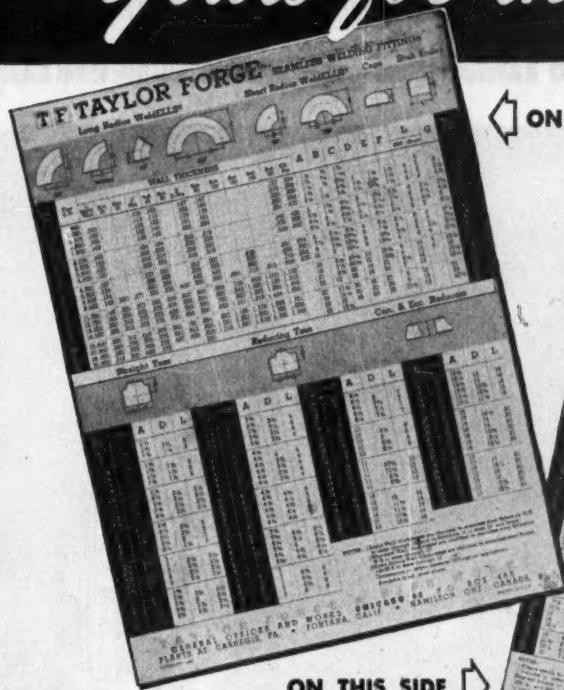
Then about six months ago some smart meddler pointed out that the plant was—and always had been—at least 50 miles from a river or any other navigable body of water!

Now the big mystery is, Who put that "dry" dock on the books?

Wits around the company say that too many people at the head office have had experience working for Uncle Sam. What else can you expect, they ask?

If you have a true Little Boner, why not send it to the Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N.Y.

# *Yours for the asking—*



ON THIS SIDE - Data on the WeldELL line



ON THIS SIDE

- Data on Taylor Forged Steel Flanges

## A VOLUME OF DATA

... covering welding fittings and forged steel flanges ...

## ON A SINGLE SHEET

Here is just about the handiest tool ever devised for the pipe designer. Data on welding fittings and flanges that otherwise could be found only by plowing through many catalog pages and tables have been ingeniously condensed on the two sides of the durable letter-size card illustrated above.

One side covers the broad WeldELL line of Taylor Forge welding fittings. For every nominal pipe size, 1/2" through 30", it shows the wall thickness for every weight of every fitting in every available material. It also shows all required dimensions of all types of fittings.

The other side covers the world's most complete line of forged steel flanges. For every nominal pipe size, 1/2"

through 24", it gives all essential dimensional and bolting data for all types of flanges in all weights. A particularly useful table (see reproduction) is that showing welding neck flange bores which enables you to determine the I.D. of any nominal pipe size without separate calculation. Thus the sheet gives you O.D. and I.D. of any weight of pipe.

The card is varnished to make it stand the steady usage you are certain to give it. To obtain your copy see your Taylor Forge distributor or

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# How CALCO uses PYREX® pipe in

Jacketed kettles cross-connected through PYREX® brand



The Jacketed kettles shown in the two views of this Calco test-run installation supply experimental products to a glass heat exchanger through 1" and 2" PYREX brand "Double-Tough" glass pipe and fittings, and a 3" glass vapor trap. Teflon gaskets are standard. Temperatures range from 125°C. to -10°C.

Pressures from 14 PSI to a vacuum of 29" of mercury. The pH range is from "very low" to 10. In the left-hand picture the operator is charging one of the kettles with concentrated acid. In the right-hand picture, he is making a valve adjustment.

# processing pharmaceuticals

## glass pipe permit either distilling or refluxing

The purity of pharmaceuticals manufactured by Calco Chemical Division, American Cyanamid Company, in its Bound Brook, N. J. plant requires the use of much glass processing equipment.

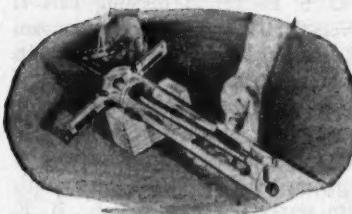
The two-still installation illustrated here is used to test run new pharmaceuticals and intermediates on a production scale a step above laboratory operations. Materials handled cover the entire pharmaceutical field, and involve a wide variety of corrosives.

According to Dr. J. M. Smith, Assistant Manager of Pharmaceutical Research, this installation's flexibility of operations is considered unlimited so far as pharma-

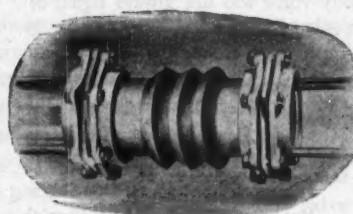
ceuticals are concerned. Part of its flexibility is due to the manner of cross-connecting the kettles so that it is possible to distill or reflux from either kettle. Most frequently, the kettles are used independently, or alternately, according to need. Both feed into one condenser.

This is only a small example of Calco's use of PYREX brand "Double-Tough" glass pipe in the production of pharmaceuticals and intermediates. Its other six plants use PYREX pipe wherever corrosion or product purity are problems. You will find it well worth your time to check the many advantages PYREX pipe offers.

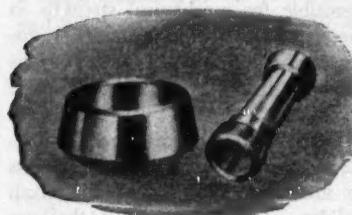
## Installation Tips



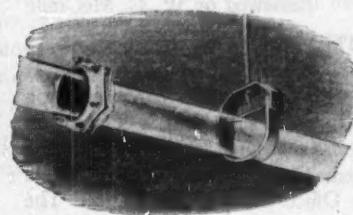
PYREX pipe can be prefabricated to your exact measurements or cut and beaded on the job by your own men with the aid of a simple tool kit.



Where excessive vibration is encountered, a Teflon bellows may be used in the line. Adjustable glass joints and spacers permit wide flexibility of layout.



Corning adapter flanges or ferrules are available for connecting PYREX pipe to other pipe materials, valves, or tank nozzles. Complete fittings also available.



Pipe hangers can be the same as used for metal pipe. It is recommended that some resilient material be used as padding to prevent scratching of glass.

The PYREX pipe distributors listed below carry the complete line

Contact the one nearest you:

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**CHICAGO 44, ILLINOIS**  
Fred S. Hickey, Inc.

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- "PYREX Cascade Coolers" (PE-8)

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# Chemical Engineers Bookshelf

*Edited by Lester B. Pope*

## Voice in the Wilderness

THE PHYSICAL CHEMISTRY OF SURFACE FILMS. By W. D. Harkins. Reinhold Publishing Corp., New York. 413 pages. \$10.

Reviewed by S. Ross

The genius of W. D. Harkins is embodied in this book, both in its strongest aspects and with its astonishing foibles. In few scientific men of genius have the defects of their qualities been more inextricably mingled with their real and valuable gifts.

This book is a summary of his latest work and the latest development of his ideas on many aspects of surface chemistry. In spite of the specialized treatment of the topics described it is not a bad book to use for an introduction to the subject, although it would require supplementing from other sources. It has the merit of starting at the beginning, and in his account of fundamentals (Chapter 1, The Nature and Energies of Surfaces) Harkins is both inclusive and precise. It is only when he begins to select the advanced topics that the very personal character of the book appears, for in each case he concludes with a description of his own work, and makes no pretense of any show of interest in any other. It is, therefore very misleading on the historical accounts. For example, the drop weight method of measuring surface tension is described elaborately in nine pages. This description has only brief, passing references to five papers other than those published by Harkins and his co-authors. By contrast, J. R. Partington in the second volume of his "Advanced Treatise on Physical Chemistry," discussing the same subject, has 148 references (10 by Harkins). The general result is not as disastrous as this example might suggest. Over a long working life Harkins had a lively interest in nearly every aspect of surface chemistry, and though the book is chiefly Harkins, yet Harkins, if any worker, can be described as the greatest contributor to the whole subject. In addition to the chapter already mentioned, the book contains chapters on films on liquids, films on solids,

properties of soap solutions and the mechanism of emulsion polymerization.

By temperament Harkins preferred to swim against the stream. In science, where, more than the layman suspects, fashions are set by accepted leaders, the voice crying in the wilderness can be shamefully neglected. Time has already vindicated some of Harkins' unpopular positions and may yet set right some of those that remain. The case made out by Harkins for multimolecular adsorption of vapors on plane solid surfaces at high relative pressures may now be taken as proved. It was an unwarranted but fashionable extension of Langmuir's ideas against which Harkins raised his voice. A similar unwarranted but fashionable extension of the ideas of H. S. Taylor is opposed by Harkins, e.g. in this sentence: ". . . some recent workers have overemphasized the effects of the heterogeneity of the surface upon physical adsorption, presumably carrying over their ideas on chemical adsorption." I believe that this statement will also be found to be true. The solitary voice was not always right, or even plausible. Nevertheless there is a stimulus to thinking in all Harkins' ideas about surface films, even when they seem most dubious.

## Lattice Theories

IMPERFECTIONS IN NEARLY PERFECT CRYSTALS. Editorial Committee: W. Shockley, J. H. Hollomon, R. Maurer, F. Seitz. John Wiley & Sons, New York. 490 pages. \$7.50.

Reviewed by W. C. McCrone

This book is a collection of 17 papers delivered in October 1950 at the Pocono Manor conference on "Lattice Imperfections." The meeting was sponsored by the National Research Council with the support of the Office of Naval Ordnance. The papers were subsequently collected and edited for publication with much of the discussion which took place at the conference.

The book is divided into four parts of which the first, Part I, has the title "On the Nature of Imperfections in

Nearly Perfect Crystals" and is concerned with basic concepts. Part II "The Role of Imperfections in Deformation" covers deformation of metals. Part III "Diffusion and Related Phenomena" deals with the motions of excess electrons and those subtle transient imperfections, excitons. Part IV "On The Properties and Effects of External and Internal Surfaces of Crystals" is concerned with grain growth in metals and with "substructures" within individual metal grains.

In the first paper, F. Seitz classifies and defines crystal imperfections and subdivides these into six primary types and three transient types. Each type is discussed from a brief historical point of view although the emphasis is on the individual characteristics of each type of imperfection and the means by which each is generated. W. T. Read, Jr. and W. Shockley also classify dislocations with subdivisions of complete and partial dislocations. The paper then deals with the nature, mechanisms of formation and consequences of dislocations.

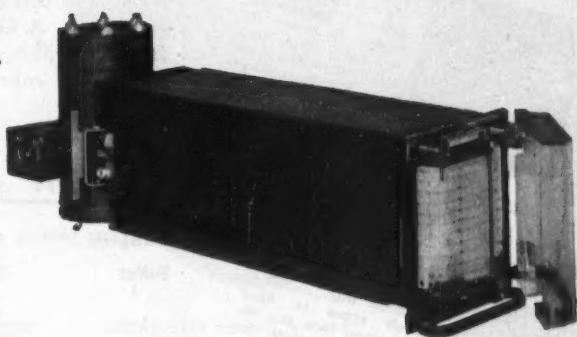
C. S. Barrett in opening Part II covers the use of diffraction as a means of detecting and analyzing twin faults in metals. He gives many alloy examples and relates some types of transformation to plastic flow. Paper 4, by W. T. Read, Jr., is a brief review of experimental data on slip lines mostly with respect to pure metals. B. E. Warren and B. L. Averbach in Paper 5 cover the theory of and application of X-ray diffraction to the study of cold work in metals. N. F. Mott (Paper 6) summarizes the factors responsible for mechanical strength in metals. J. S. Koehler (Paper 7) discusses the influence of imperfections on the elastic constants of metal single crystals.

Part III opens with Paper 8 by R. G. Breckenridge on relaxation effects in ionic crystals such as the alkali halides, silver chloride and thallium halides. L. Apker and E. Taft discuss F-centers in alkali halides having halogen vacancies and the relation between photo-electricity and these F-centers. J. Bardeen and C. Herring formulate a theory of diffusion for a two-com-

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receiver mechanisms kept clean by self-purging feature!

both receiver and controller plug in like a radio tube!



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CORROSIVE atmospheres, dust or fly ash can't get into the mechanism of Taylor's TRANSET\* Receivers because the protective case or sleeve is *self purging*. Even the simplest receiver can be provided with the self-purging feature. In fact, the TRANSET receivers have corrosion-resistant qualities comparable with those of the well known FULSCOPE\* line of controllers, thus making them completely suitable for all industrial service. Both Receivers and Controllers plug in like a radio tube. You can change from the simplest to the most complete control by simply pulling out one unit, plugging in another.

#### NOTE THESE FEATURES TOO

A single mounting is all you need for both controller and recorder or indicator. All units can be mounted on the panel without welding, without drilling holes. And you can change from indicator to recorder, or vice versa, in only 10 seconds.

Protective sleeve or case permits both self-purging feature as well as complete mechanical protection to receiver mechanism.

The only piping connections required are air supply, controller output and to the variable transmitter. All other connections are made automatically, in the self-sealing manifold.

\*Reg. U. S. Pat. Off.

All adjustments on recorder or indicator can be reached conveniently, from the front, without disturbing any connections.

You save panel space, because units can be mounted only a few inches apart. You save money, both in labor and materials on installation, thanks to the simplified piping and mounting.

Continuous valve position indication on separate scale tells valve air pressure at a glance.

Chart read-back device gives easy access to past records without disturbing any function of the recorder or interrupting the record.

A new chart drive mechanism for greater convenience, greater dependability.

Thanks to its corrosion and dust-proof qualities, this plug-in-type Taylor TRANSET Control System is particularly suitable for use in chemical industries and refineries. Call in your Taylor Field Engineer, or write for full information. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

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#### BOOKSHELF, cont. . .

ponent system in which they consider the Kirkendall effect. C. Zener also presents a theory of diffusion.

Part IV begins with Paper 12 by J. C. Fisher and C. G. Dunn on surface and interfacial tensions of single-phase solids. W. T. Read, Jr. and W. Shockley present a dislocation model for grain boundaries. C. S. Smith discusses the behavior of interphase interfaces as distinguished from grain boundaries between crystals of the same phase. A. Guinier discusses substructures within single grains and the X-ray and microscopic techniques

necessary for their study. B. Chalmers distinguishes between the properties and effects of grain boundaries. The final paper by R. Smoluchowski (17) deals with movement and diffusion phenomena in grain boundaries.

This book summarizes and brings up-to-date a rapidly moving and hitherto uncollected field of research which is of great importance especially in the field of metallurgy. There is little overlapping of chapters or confusion in terminology as might be expected and the book will be valuable and useful to the theoretical physicist and chemist as well as the more practical engineer and metallurgist.

## Recent Books & Pamphlets

### Subject

Sulfur

### Summary

Calculations of certain thermodynamic functions to high temperatures for gaseous sulfur (monatomic and diatomic), sulfur monoxide, sulfur dioxide, sulfur trioxide and hydrogen sulfide from molecular and spectroscopic data. Values of the heats of formation of the various atomic and molecular species are selected from published experimental data and certain industrially important equilibria are calculated. 8 pages.

Magnesium

Study of the magnesium-rich side of the magnesium-zirconium constitution diagram for the purpose of improving the information on this subject. The diagram developed is similar in form to that found by previous investigators, but the phase boundaries differ as to temperatures and alloy compositions. 8 pages.

Low-temperature Physics

Reports on 61 papers on low temperature physics. These papers discuss various aspects of such subjects as superconductivity, calorimetry, thermometry, second sound, flow properties of helium II. 291 pages.

High Polymers

Studies of the effect of sorbed moisture on compressibilities of leather, cellulose, wool and silk fibroin. Empirical compression equations are given. 5 pages.

German Industry

How scientific research can be applied on a large scale to promote the technical advancement of West Germany's industry and thereby to raise the country's productivity level. Report of a MSA investigating team of specialists sent to West Germany. 50 pages.

Raw Materials

Listing of active industrial mineral producing companies in Oregon, Washington, Idaho, Montana and British Columbia. 12 pages.

### How to Order

RP2350 By William H. Evans and Donald D. Wagman. Supt. of Documents, Washington 25, D. C. 10 cents.

RP2352. By J. H. Schaum and H. C. Burnett. Supt. of Documents, Washington 25, D. C. 10 cents.

C519. Supt. of Documents, Washington 25, D. C. \$1.75.

RP2349. By C. E. Weir. Supt. of Documents, Washington 25, D. C.

PB111082. Office of Technical Services, Dept. of Commerce, Washington 25, D. C. \$1.25.

IC No. 8. By A. O. Bartell. Raw Materials Survey, 701 Woodlark Bldg., Portland 5, Ore. (Continued)

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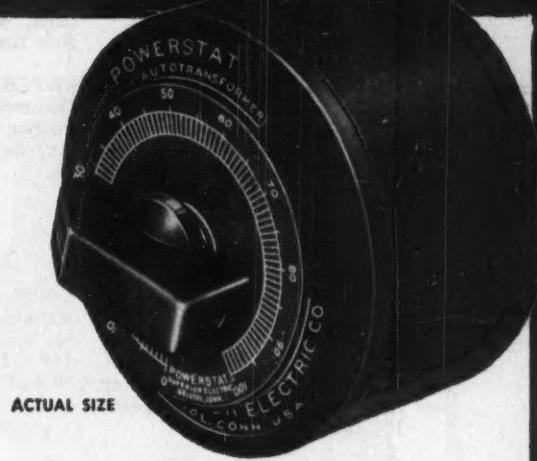
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RECENT BOOKS & PAMPHLETS, CONT. . .

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**Water** Report on a comprehensive research project on water-quality criteria in California. The research comprised a literature survey and the preparation of a compendium of all known data on the subject with regard to almost all beneficial water uses and most contaminants and pollutants. 512 pages.

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**Compressed Air** Discusses such uses of compressed air as: actuation by air cylinders, agitation of liquids, blast cleaning, chipping and scaling, clamping, drilling, forging, grinding, hoisting, instrument control, molding and die casting, spraying. 36 pages.

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**Asbestos** Uses, production, trade and supply of this strategic material.

**Amyl Nitrite** Temperature limits of flammability in air; lower temperature limit of flammability in oxygen; ignition temperatures. Graphs. 6 pages.

**How to Order**

"The Problem of Maintenance Costs." By Jackson D. Leonard. R. S. Aries & Associates, 400 Madison Ave., New York 17, N. Y. Gratis.

SWPCB Publication No. 3. Documents Section, State Printing Div., 11th and O Sts., Sacramento 14, Calif. \$3.

"British Chemicals and Their Manufacturers, 1953." Assn. of British Chemical Mfrs., 166 Piccadilly, London, W.1., England. Gratis.

"Compressed Air Power in Industrial Production." Compressed Air and Gas Institute, 1410 Terminal Tower, Cleveland 13, Ohio. 25 cents.

"Methods for Treating Metal-Finishing Wastes." Ohio River Valley Water Sanitation Commission, 414 Walnut St., Cincinnati 2, Ohio. \$2.

SD-50. Manufacturing Chemists' Assn., 246 Woodward Bldg., 15th & H Sts., N.W., Washington 5, D. C. 25 cents.

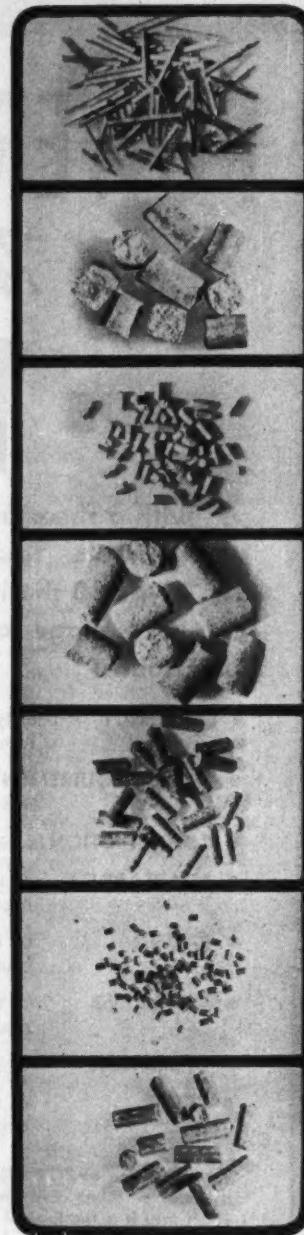
Research Bulletin 18. By O. T. Bloomer and K. N. Rao. American Gas Assn., 420 Lexington Ave., New York 17, N. Y. \$3.50.

"Manual for the Design of Ferrous and Non-Ferrous Pressure Vessels and Tanks." Fourth edition. By Karl O. Siemon. Edwards Bros., Inc., Ann Arbor, Mich. \$3.85.

Report M-3, U. S. Tariff Commission, Washington 25, D. C.

"Flammability of Amyl Nitrite." By M. G. Zabetakis and G. W. Jones. RI-4877. Bureau of Mines, U. S. Dept. of the Interior, Pittsburgh, Pa.

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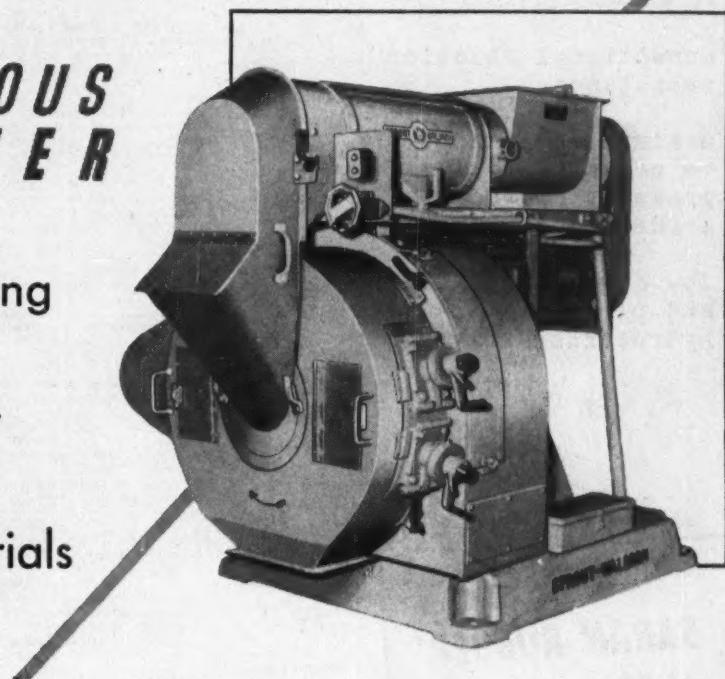
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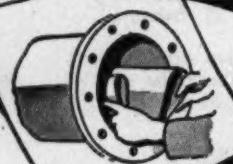
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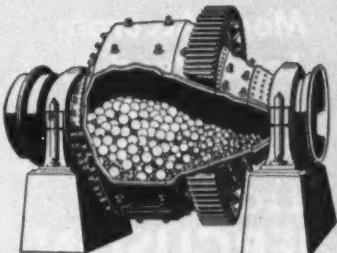
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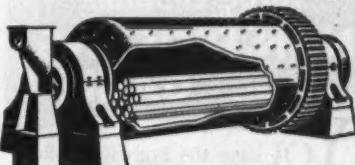
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<b>Waste Treatment</b>	approach treatment of sewage, polluted water and industrial wastes in a new and efficient way with a powder comprised of a modified, buffered hypochlorous acid. 4 p.	<b>Guardian Chemical Corp.</b>	10-15 43rd Ave., Long Island City 1, N. Y.
<b>Demineralizers</b>	save operating time, trouble and money with a fully automatic mono-column demineralizer. Schematic diagram, description of parts, sample specifications and performance data. 2 p.	<b>Penfield Mfg. Co.</b>	19 High School Ave., Meriden, Conn.
<b>O-Rings</b>	choose O-rings with special specifications. Dimensions for both regular and special sizes and a detailed table of tensile strength, hardness, compressibility and other features. 2 p.	<b>Bacon Industries</b>	192 Pleasant St., Watertown, Mass.



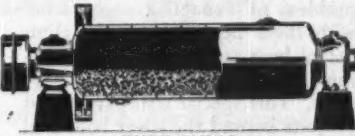
**HARDINGE CONICAL MILLS**



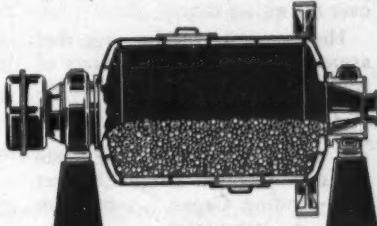
**ROD MILLS**



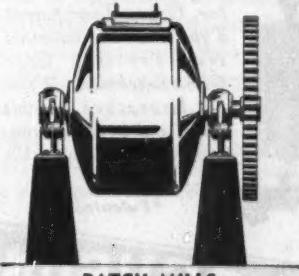
**TRICONE MILLS**



**TUBE MILLS**



**CYLINDRICAL MILLS**



**BATCH MILLS**

**Write for Bulletin AH-440-11 on complete line of Hardinge Mills.**

**HARDINGE**  
COMPANY INCORPORATED

YORK, PENNSYLVANIA—240 Arch St., Main Office and Works  
NEW YORK 17 • SAN FRANCISCO 11 • CHICAGO 6 • HARRISBURG • TORONTO 1  
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**More Accurate  
Level Reading  
of LOW  
TEMPERATURE  
LIQUIDS . . .  
JERGUSON  
Large Chamber  
NON-FROSTING  
GAGES**

**Y**OU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

**Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.**

\*Patented

**JERGUSON**

Gages and Valves for the Observation of Liquids and Levels

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Offices in Major Cities  
Jerguson Bros. Gage & Valve Co., Ltd., London, Eng.  
Pétrole Service, Paris, France

**NEW TECHNICAL LITERATURE, cont. . .**

**What's  
New  
In . . .**

**Pumps**

take advantage of the increasing application of hydraulic control to many types of machinery. Six basic units described here: balanced vane types pumps; axial piston type pumps; pressure control valves; volume control valves; directional control valves; hydraulic motors. 56 p.

**Fire  
Retardants**

apply this company's Aerotex fire-retardant finishes.

**Materials  
Handling**

choose loading assemblies, bulk plant loading and unloading equipment. Blueprints and photographs. 24 p.

**Castings**

produce stainless alloy castings with a new shell molding process. Describes facilities to handle development work involving unusual and complex casting problems and alloys. 8 p.

**Instruments**

find timers for use in boiler water-feed and chemical-feed pumping, sampling procedures, sewage-disposal clarifiers, central lubricating systems where short, accurate, variable-duration "on" time is required.

**Instruments**

apply this company's direct writing recorders. Data, examples. 6 p.

**Boiler  
Control**

control combustion, feed water, boiler steam temperature and boiler cleaning with a completely integrated system. 10 p.

**Soot Blowers**

judge the performance of this company's Automatic-Sequential Soot Blowers. Discusses 15 central station installations. 32 p.

**Instruments**

evaluate filter paper strips and sheets as obtained by partition chromatography and paper electrophoresis. 4 p.

**Chains**

buy and maintain steel detachable chain or design other type applications using this chain. 44 p.

**Plastic  
Pipe**

capitalize on the superior flow characteristics of plastic pipe. Charts and graphs give data on head loss due to friction in the pipe.

**Temperature  
Control**

use temperature-sensitive tabs of calibrated melting points to handle special problems. 2 p.

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handle and use sodium dispersions, a highly reactive form of sodium. Detailed instructions for the preparation of a typical sodium dispersion. 4 p.

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find a use among your operations for scintillation and geiger counting instruments. 8 p.

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select and apply helical gear drives. Full-page cross-sectional views show in detail the design and construction features of both the double and triple reduction types. Installation photographs. 16 p.

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plan a control center. Layout charts and floor arrangements. Purpose and construction of this company's multi-unit control centers. 28 p.

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get a portable, gasoline engine driven pump which will handle, 6,000 gph. at 17 ft. suction lift (including friction) against 17 ft. total head. 4 p.

**Pumps**

supply yourself with centrifugal pumps for coolants, cutting oils. Line drawings and photographs of typical installations on many types of machine tools. 8 p.

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automatically control temperature, pressure, liquid level, humidity or other process variables with this company's circular case controller. 16 p.

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judge the relative advantages and limitations of two nonelectrolytic nickel-coating processes. Operation of the processes, the nature of the deposits, physical properties, protective value, efficiency and potential applications are discussed. 4 p.

**Company . . .**

Vickers Inc., 1400 Oakman Blvd., Detroit 32, Mich.

American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

OPW Corp., 2735 Colerain Ave., Cincinnati 25, Ohio.

Solar Aircraft Co., 2200 Pacific Highway, San Diego 12, Calif.

Paragon Electric Co., Two Rivers, Wis.

Sanborn Co., 38a Osborn St., Cambridge, Mass.

Copes-Vulcan Div., Erie 4, Pa.

Copes-Vulcan Div., Erie 4, Pa.

Photovolt Corp., 95 Madison Ave., New York 16, N. Y.

Chain Belt Co., Dept. P. R., Milwaukee 1, Wis.

Carlton Products Corp., 10225 Meech Ave., Cleveland 5, Ohio.

Tempil Corp., 11 West 25th St., New York 10, N. Y.

Ethyl Corp., 100 Park Ave., New York 17, N. Y.

R-C Scientific Instrument Co., 335 Culver Blvd., Playa Del Rey, Calif.

V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.

Allen-Bradley Co., Milwaukee, Wis.

Carver Pump Co., Muscatine, Iowa.

Pioneer Pump & Mfg. Co., c/o Denham & Co., 925 Pook Bldg., Detroit 26, Mich.

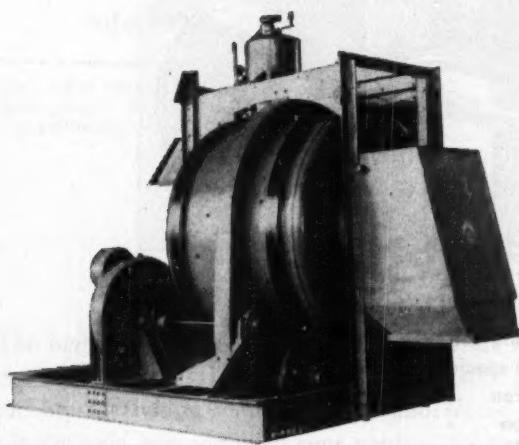
Foxboro Co., Foxboro, Mass.

International Nickel Co., 67 Wall St., New York 5, N. Y.

—End



## He can't stand that slow mixing cycle!



**THE MODERN WORTHINGTON CHEMICAL MIXER** is available in sizes up to 110 cu ft or 3 tons per batch. Each mixer is equipped with a measuring tank for various chemical applications.

**WORTHINGTON**  
  
**Industrial Mixers**

But it isn't *that* bad, friend. Give us a chance to help. We've got a mixer that can boost your daily output as much as 10 per cent. It's the Worthington chemical mixer with an engineered blade design that gives you a mixing action faster than any we know of. It saves time with every batch, can be set up for continuous agitation, mixes thoroughly, and eliminates these other big problems as well:

**CORRODED DISCHARGE CHUTE**—The Worthington discharge chute is out of the mixer during mixing time. Proper balance makes manual control of chute easy. Pneumatic controls are also available.

**WOBBLY DRUM ROLLER**—Worthington drum rollers are of genuine carwheel metal, ground to close tolerances. Drum roller shafts are easily adjustable to compensate for wear.

**HEAVY HORSEPOWER CONSUMPTION** — Worthington's specially engineered, anti-friction construction assures peak operating efficiency with lowest possible horsepower consumption.

VR.3.2

**SEND THIS COUPON TODAY** to learn more about how to reduce mixing time and cost with a Worthington chemical mixer. There's a skilled Worthington engineer near your plant. At your request, he'll be glad to call on you.

Worthington Corporation  
 Industrial Mixer Division  
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Name.....

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City..... Zone..... State.....

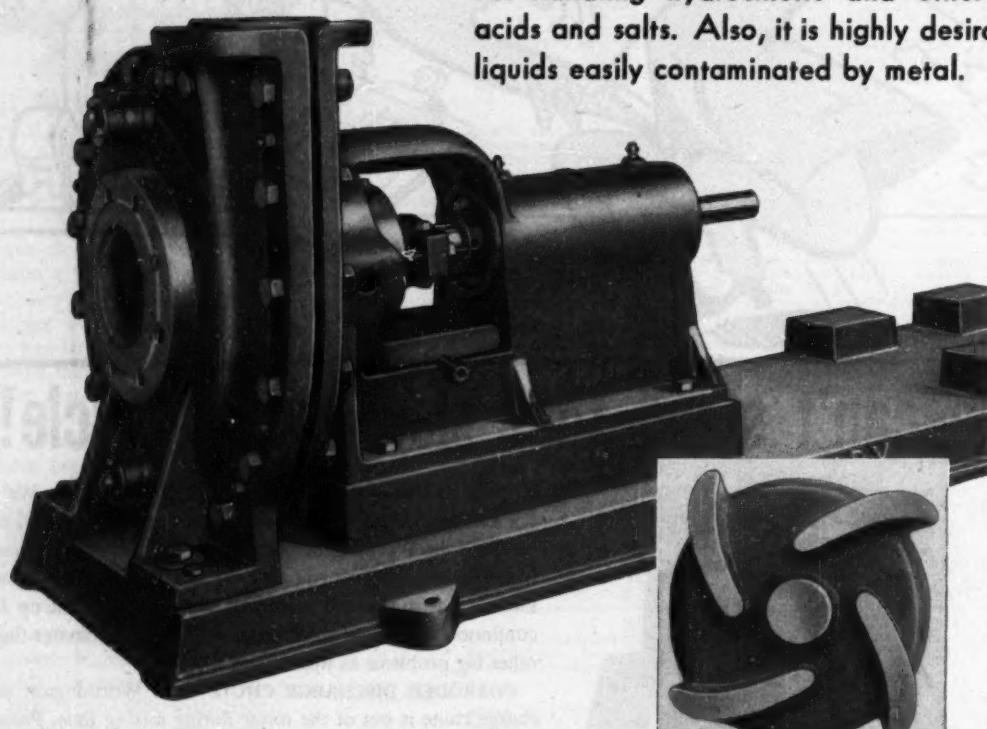
I'd like more information.  I'd like to talk with an engineer.



# RUBBER LINED CHEMICAL PUMPS

## Warren-Quimby Type DB

For handling hydrochloric and other strong acids and salts. Also, it is highly desirable for liquids easily contaminated by metal.



Pump Casing is lined and impeller covered with Rubber

1. Specifically built for acids and corrosive salts
2. Custom rubber lined to meet special requirements
3. Resistant to chemical corrosion
4. Resistant to physical abrasion
5. Sound rubber-to-metal bond
6. Capacities, to 2000 G.P.M., heads to 125 feet
7. Sizes,  $\frac{1}{2}$ " to 8"
8. Over-size bearings
9. Baseplate drip-protected

## Advantages

Write for  
**Bulletin WQ-212**

CG-8

# WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS



# Wyandotte Caustic Soda is now available in convenient open head drums!

Look  
at these  
advantages:

## Safety!

The rolled edges and open head protect the user from cuts and caustic burns.



## Visible Supply!

No more guesswork. You can instantly see how much caustic remains in the drum.

## Easily Accessible!

No more tilting, or turning the drum upside down to get at the remaining caustic.



The high quality of Wyandotte caustic in the new open head drums is unchanged. You'll still find among Wyandotte's many grades and forms the caustic soda best suited to your needs — for soaps, detergents and metal cleaners; food processing; paints, inks and dyes; for insecticides and textiles.

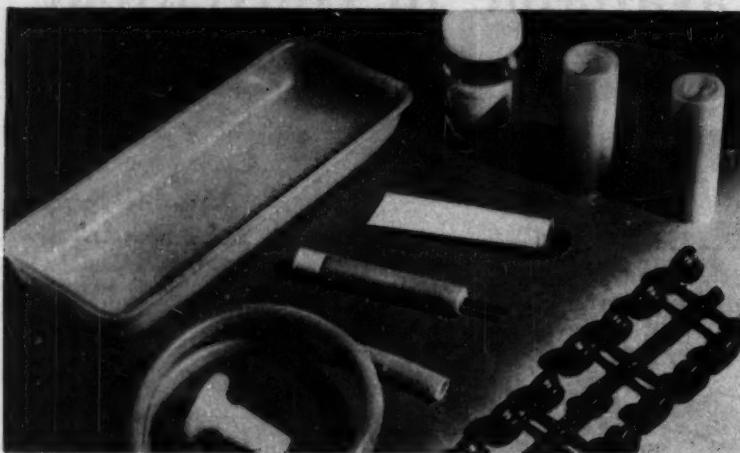
You'll find Wyandotte a reliable and helpful source for all alkalies — caustic, soda ash, bicarbonate of soda, chlorine, calcium chloride. Write Wyandotte for our new caustic soda booklet . . . for help in specifying the right grade for your processes, consult Wyandotte.

## For Pilot-Plant Operations

Wyandotte Mercury Cell Caustic (50% liquid) can be obtained in nickel drums for pilot-plant operations, as well as in commercial quantities. This reagent-grade caustic is ideal for pilot-plant use, since the grade need not be changed when you convert to commercial production. This eliminates the "bugs" that often arise when a different grade is used in production than in the pilot-plant process.

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WYANDOTTE, MICHIGAN  
OFFICES IN PRINCIPAL CITIES

WYANDOTTE  
CHEMICALS



## Plastics on the Move

**After stumbling over some hurdles in early 1952, the plastics industry is really pouring it on now. And, there's plenty of speed in reserve.**

No section of the chemical industry has grown more rapidly than plastics. They enter a host of different end uses in many industries. And plastics manufacturers, themselves, are major users of basic chemicals.

The output of synthetic resins reached 5.9 million pounds in 1922. Thirty years later production had risen by 450 times. Close examination reveals that the industry more than doubled its output every five years (see table).

► **Nature of the Industry**—The industry's 5,000 or so firms employ nearly a quarter of a million workers in two major branches. One branch concerns itself with the manufacture of the various synthetic resins and celluloses and includes the leading producers of chemicals, rubber, glass and rayon. The second branch—which includes thousands of firms—molds and shapes these basic materials into finished products.

Barely a third of the output of all resins goes into molded products such as radio cabinets and clock cases. The balance is used in veneers, surface coatings and adhesives. Almost two thirds of total production is earmarked for industrial and military products.

► **Plastics Popularity**—The hard core of appeal that plastics have for business-

men is their ability to do a job. Plastics have been able, in many cases, to replace wood, glass, leather, rubber and porcelain.

But plastics are more than a substitute. They are basically new products with distinctive properties. They are characterized by a high strength-weight ratio, good corrosion resistance, low water absorption, exceptional moldability, permanent colorability and high dimensional stability.

These advantages have been sought eagerly by appliance producers, by builders and by manufacturers of all forms of transportation equipment. To attempt to list all the current uses that engineers and businessmen have found for the different plastics would be to court disaster, the list is that long. But anybody who has even brushed against this fast-moving industry knows that industrial research has barely begun to tell the story about potential uses for plastics.

► **Celluloses Lag**—One part of the plastics industry that hasn't shared in the general growth is the celluloses. The quality imparted by these plastics is not up to the standards of the various resins.

For example, celluloses used to be an important element in safety glass. Now, manufacturers have switched to

the vinyl resins. Cellulosics are also used in the manufacture of acetate yarns, but the development of the newer manmade fibers indicates that this particular outlet is not likely to expand very much.

Among the general line chemical companies, Union Carbide and Carbon, Dow Chemical and Monsanto are the big three in plastics output. But expansion of producing capacity is not confined to these leaders. All chemical companies who have a finger in the plastics pie are concentrating their efforts on turning out more basic materials.

Molders, laminators, extruders and fabricators, too, are gearing their plants to handle a larger volume of business. And manufacturers of machinery are turning out bigger, better and faster machines to improve the efficiency with which plastics can be shaped into end products.

► **Peek Into the Future**—Kaiser-Frazer has announced plans to start production—sometime this summer—of a sports car made of fiberglass-reinforced plastic. Heretofore, reinforced plastics were used, for bodies, only in custom-built models.

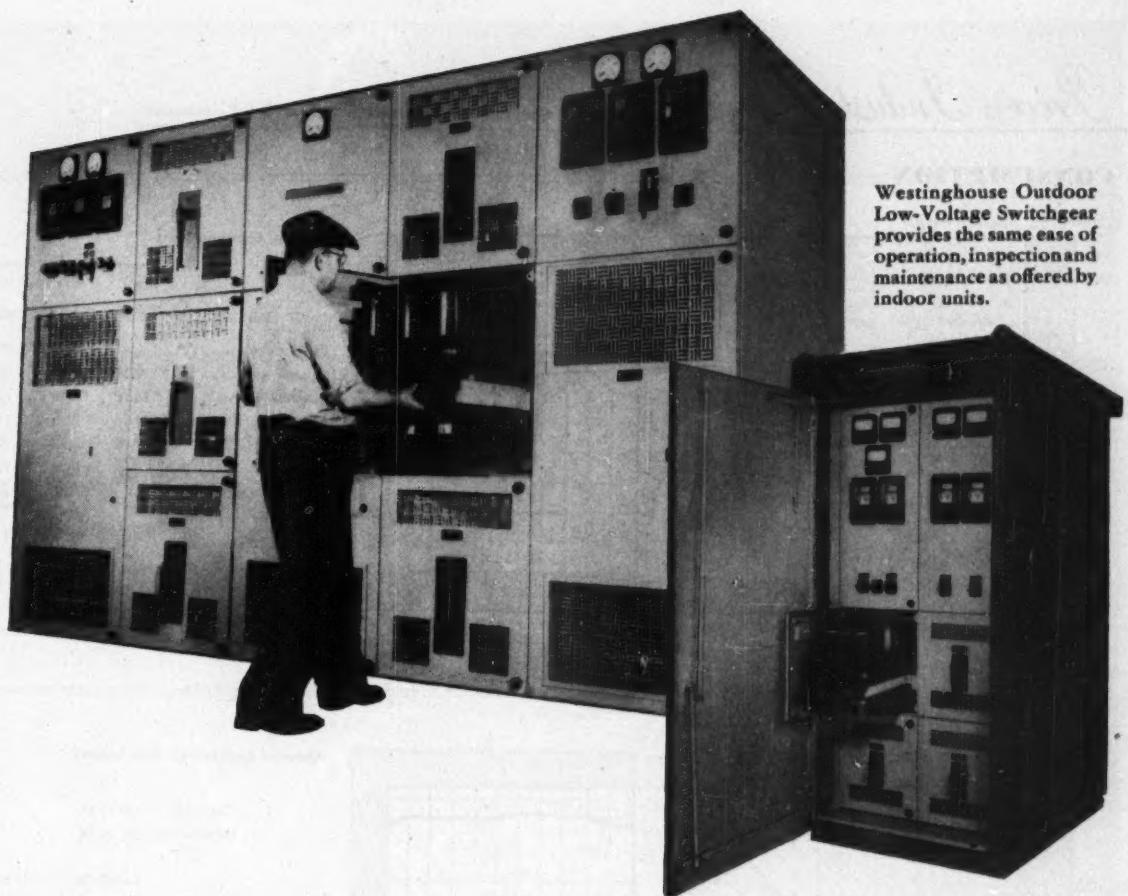
In a matter of weeks, washing machines will be made with some plastic parts. Refrigerators manufacturers, too, are planning to expand considerably the role of plastics in their finished products. And the armed forces continue to discover new uses for the products of the plastics industry. The armored vest now worn by GI's in Korea is a recent dramatic and practical example.

In 1952, per capita consumption of plastics barely reached 17 pounds. This is but an insignificant fraction of the per capita use of metals. With industrial research proceeding feverishly, though, and with the tremendous expansion of capacity, it is likely that the industry will be able to keep up its near-incredible record of doubling output every five years—at least through 1960.

### Synthetic Resin Production

(Millions of pounds)

1922	5.9	1947	1,251.7
1927	13.5	1948	1,480.9
1932	29.0	1949	1,491.1
1937	163.0	1950	2,180.5
1942	426.7	1951	2,441.4
1945	818.0	1952	2,600.0
1946	994.3	1953 (est.)	2,800.0



Westinghouse Outdoor Low-Voltage Switchgear provides the same ease of operation, inspection and maintenance as offered by indoor units.

## Now . . . flexible protection in less space WITH WESTINGHOUSE LOW-VOLTAGE SWITCHGEAR

When you specify Westinghouse Low-Voltage Switchgear you get the most flexible low-voltage circuit protection available today. And you get it in compact, unitized enclosures that save valuable plant space . . . save you considerable planning expense . . . can be installed in a matter of hours.

An unusual degree of flexibility results from the modern selective tripping feature of the DB De-Ion® Breaker. In a single, compact device, you get the perfect co-ordination of time-delay characteristics, which confines outages to the faulted section alone, to assure maximum continuity of service.

The Westinghouse Low-Voltage Switchgear design provides easy access to all components . . . simple

drawout breaker operation . . . a complete metal enclosure for safety. It is available for circuits up to 600 volts, 15,000 to 100,000 amperes interrupting duty, for indoor or outdoor service.

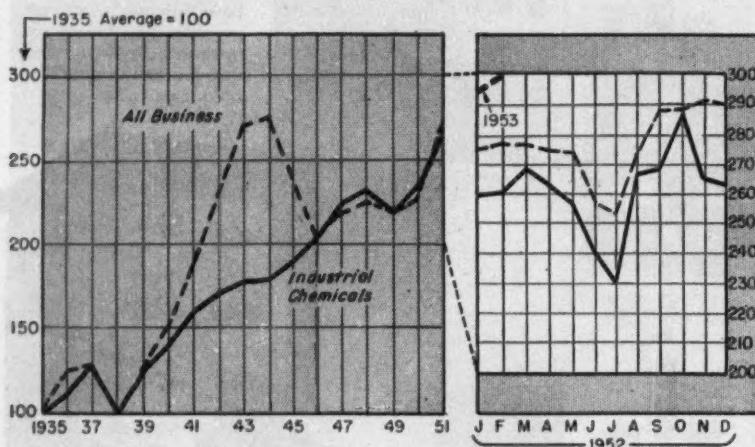
For complete information on Westinghouse Low-Voltage Switchgear, write for Booklet B-5282. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60794

YOU CAN BE SURE . . . IF IT'S  
**Westinghouse**  
**LOW-VOLTAGE**  
**SWITCHGEAR**

# Process Industry Trends

Douglas Greenwald, McGraw-Hill Dept. of Economics

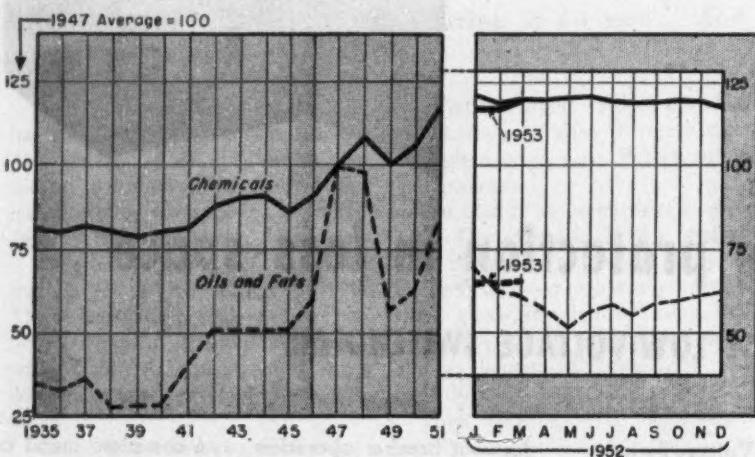
## CONSUMPTION



## Industrial Chemicals Index

INDEX	January (Est.)	December (Prelim.)	November (Revised)
Fertilizer.....	265.50	264.65	265.22
Pulp and paper.....	28.38	28.45	29.55
Petroleum refining.....	28.40	27.99	27.42
Iron and steel.....	18.14	17.77	17.31
Rayon.....	29.86	30.03	28.97
Glass.....		19.54	20.82
Paint and varnish.....		22.50	23.05
Textiles.....		10.36	11.81
Coal products.....		11.61	11.38
Leather.....		4.45	4.53
Explosives.....		8.21	8.67
Rubber.....	6.84	6.56	6.12
Plastics.....		20.75	20.43

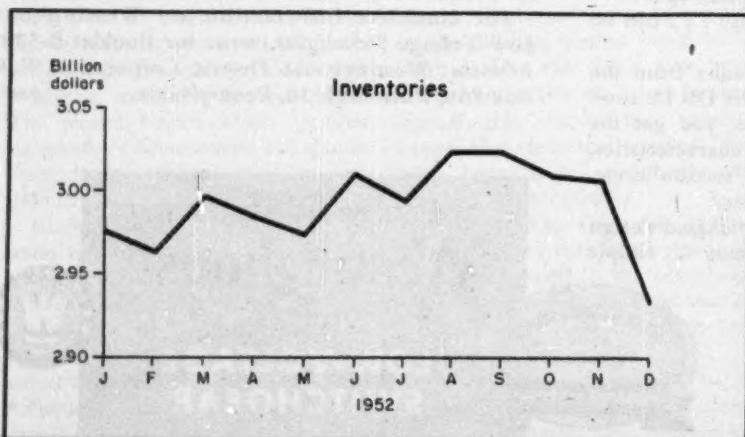
## PRICES



## Chemical Engineering's Price Indexes

Chemicals	UP +1.4%
Oils and Fats	UP +0.1%
As of March 1, 1953.....	119.07
Last month.....	117.39
March 1, 1952.....	120.71
March 1, 1951.....	118.98
	63.71
	63.62
	63.23
	98.69

## HIGHLIGHT OF THE MONTH



## A Sharp Drop

At the beginning of this year, manufacturers of chemicals and related products were in a relatively good position—inventory-wise. While inventories of other manufacturing industries were higher, stocks of chemical manufacturers were at the lowest they have been since August 1951.

The big decline in inventories was centered in industrial chemicals where the drop between Dec. 1, 1952, and Jan. 1, 1953, was more than \$40 million. The decrease in drugs, medicines and soaps group totaled \$27 million.



## REVERE OFFERS 4-WAY COLLABORATION

Revere offers you more than metal. You can benefit from our four-way collaboration, and we suggest you look into these extra services.

1. Revere salesmen often save customers money. They may recommend a less expensive alloy if it will serve as well as a more expensive one. Or they may suggest an extruded shape, costing more than plain bar, but saving important sums by reducing costly machining operations. They are capable of giving sound advice, because they are well trained and experienced, and take a sincere and informed interest in the welfare of buyers.
2. The Revere Technical Advisory Service was established by Revere over 20 years ago, as a nation-wide organization whose duty it is to collaborate with engineers, designers and production men, seeking ways to solve problems, cut costs, improve products, or all three.
3. The Revere Research Department operates a laboratory, staffed by engineers and scientists, and equipped with the latest scientific apparatus, including the spectrograph and X-ray diffraction. This Department is called upon by salesmen and Technical Advisors when they find it necessary to obtain thorough physical and chemical analyses, and base their recommendations upon such findings.
4. The Revere Mills, located in industrial centers from coast to coast, are an integral part of our organization, collaborating closely with the other three services. They give you exactly what you require, as to alloy, size, gauge, temper, finish, and their experience is often invaluable in helping to solve tough problems.

Please note that this four-way service, originated by Revere, does not take the place of your own engineers, designers or production men. It collaborates with them, confidentially. There is no charge or obligation. To obtain this service, get in touch with the nearest Revere Sales Office.

# REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801  
230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.;  
Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.  
Sales Offices in Principal Cities, Distributors Everywhere.

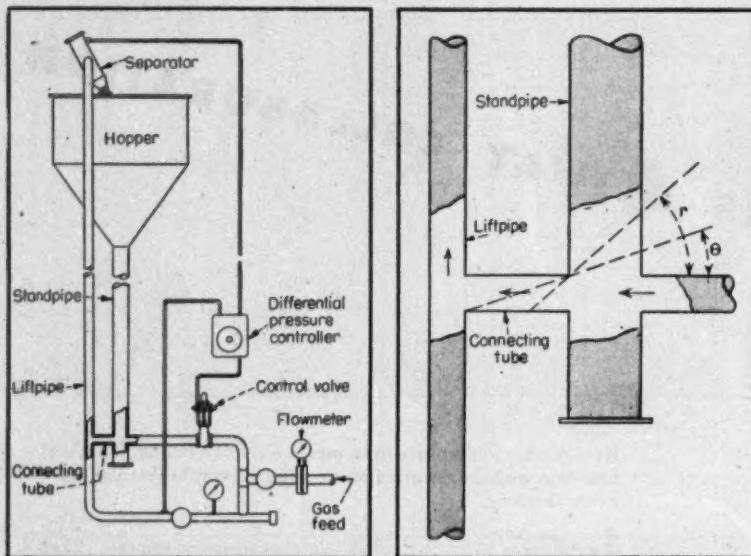
SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

COPPER ★ BRASS ★ ALUMINUM

# Tomorrow's Technology

Melvin Nord, Chemical Engineer & Patent Attorney, Detroit, Mich.

## EQUIPMENT PATENTS



### New Feeder for Loose Solids

**Here's a simple way to feed loose solids into a gas lift or other pneumatic conveyor. Controlled flow is accomplished without valves.**

Most solids feeders depend on valves, variable orifices or other mechanical devices with moving parts to obtain controlled flow. Here's one that doesn't. Howard W. Hill has assigned the invention, U.S. 2,623,793, to The Dow Chemical Co.

A supply of loose solids is held in a hopper or other receptacle and flows by gravity through a standpipe (see cut). The total height of the column of solids in the standpipe and hopper provides the necessary static head.

The standpipe is connected to the lift pipe by a connecting tube whose diameter is equal to that of the lift pipe. The length of this tube must be greater than its diameter so that solids flowing into it and assuming their normal angle of repose will not reach the lift pipe.

On the other hand, the tube length must not be so great as to interpose excessive friction. Also, it's necessary to keep the angle  $\theta$  less than the angle

of repose  $r$ , but greater than  $1/4$ -preferably about  $1/3$ .

A separator is provided at the top of the lift pipe into which the solids are discharged. There they are separated from the lift gas and flow by gravity to the hopper or to another receiver.

► **Split Gas Feed**—The fresh lift gas is split into two streams. One goes directly to the lift pipe and the other passes through the connecting tube, blowing the solids from the standpipe to the gas lift. The rate of flow of gas through the connecting tube is regulated by a control valve in response to the difference in pressure across the gas lift.

The height of the column of solids in the standpipe should be such that the weight of solids per unit cross-sectional area is substantially greater than the gas pressure differential across the standpipe. This will prevent interference with the flow of solids.

The quantity of solids fed into the lift is proportional to the flow of gas

through the connecting tube. This can be adjusted by setting the differential pressure controller, while keeping the total flow of gas constant.

### Drying by the Heat Pump Principle

In U. S. 2,622,342, Noel Goulounes and Albert E. Caillat disclose a continuous drying apparatus which is in part based on the heat pump principle.

Granular material to be dried is introduced at the top of a vertical tower, falls downward by gravity, and is discharged at the bottom. Coils pass horizontally through the tower providing the necessary heat transfer surface.

The material is heated to nearly 100 deg. C. in the upper section by exchange with hot water in the coils. It is then heated further with steam in coils at 105-110 deg. C., thus evaporating moisture from the material being dried. The water vapor formed here is compressed and makes up the steam used for heating in the evaporation section.

Before the dried material is discharged, it is cooled by water passing through coils in the lower section of the tower.

### Liquid Level Measurement by Electrical Capacitance

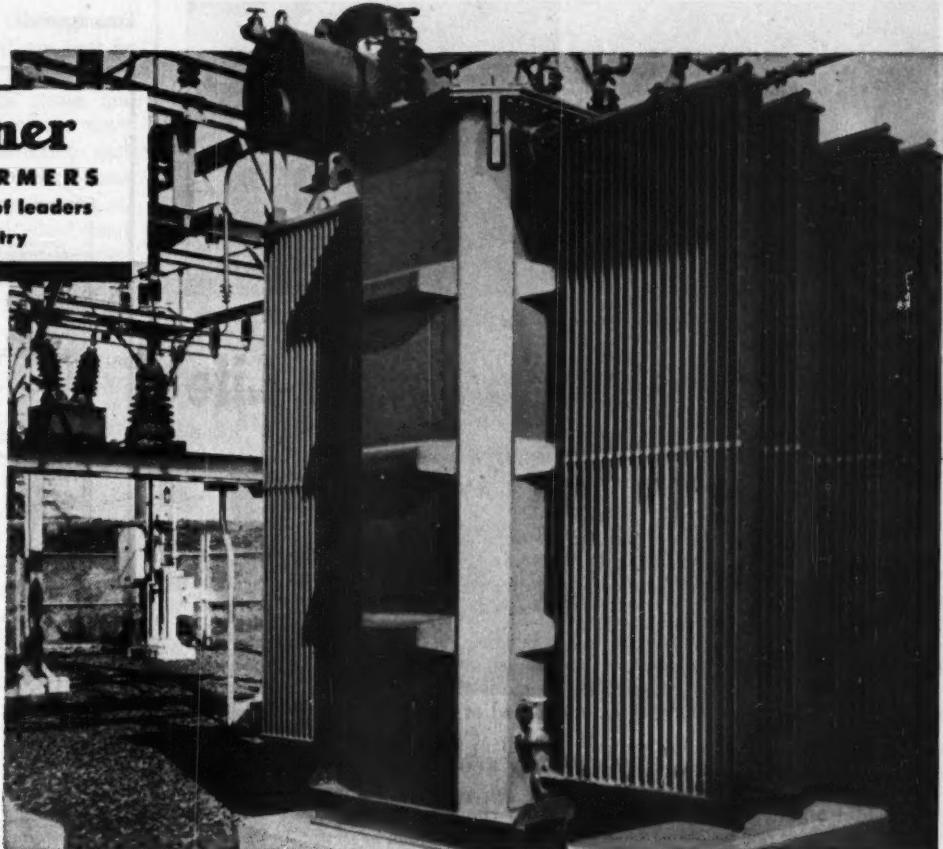
In this new device, liquid level is determined by variations in capacitance between a pair of vertical condenser elements. As liquid level changes, capacitance also changes.

A balancing condenser compensates for variation in dielectric constant of the liquid, thus permitting the instrument to be used for liquids of widely varying characteristics in the same storage tank. The instrument is said to be rugged and durable, and to be especially useful for indicating the level of liquid hydrocarbons in tank cars or bulk storage tanks.

Deslonde R. Boisblane and Lyman M. Oberlin have assigned the patent, U. S. 2,622,442, to Phillips Petroleum Co.

# Wagner

TRANSFORMERS  
...the choice of leaders  
in industry



## to help make good foods better...

### The Vitamin Division of

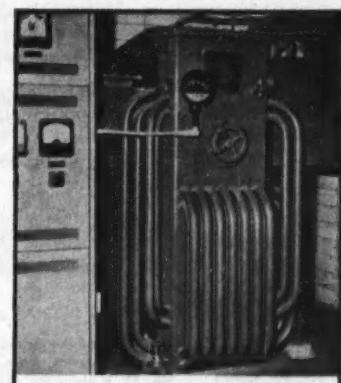
Hoffmann-LaRoche, Inc., at Nutley, New Jersey helps food processors "keep faith with nature." It produces ascorbic acid that protects processed foods from loss of natural color and flavor and adds to their nutritional value. It produces vitamins for the enrichment of bread, cereals, and other grain foods.

The Hoffmann-LaRoche plant—like all modern industrial plants—depends on electricity as its source of power for production. Wagner transformers play an important part in powering production at Hoffmann-LaRoche.

The 4000 kva Wagner Power Transformer, shown above, supplies the power for the plant. Five additional Wagner distribution and substation transformers, rated from 100 to 500 kva, distribute power at the right voltage for use at various load centers throughout the plant.

Wherever electric power is used—in industry, commerce, city and farm—Wagner Transformers efficiently and dependably handle their unending job of supplying proper voltages for every purpose.

A Wagner engineer can help you select the right transformers for your requirements. Consult the nearest of our 32 branch offices, or write us.



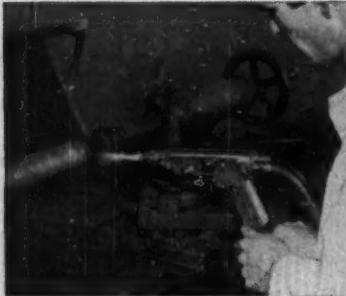
Wagner 500 kva Noflamol Unit Substation Transformer installed at Nutley, New Jersey plant of Hoffmann-LaRoche, Inc.

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**Wagner**  
Electric Corporation  
EST. 1891

**WAGNER ELECTRIC CORPORATION**  
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES  
AUTOMOTIVE BRAKE SYSTEMS • AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES



First . . . spray the Colmonoy alloy on. Second . . . fuse it to the base metal.

TOMORROW'S TECHNOLOGY, cont. . .

## Two short steps to Longer Life

*Spray and weld—that's the easiest, least expensive method of hard-facing pump parts.*

Spraying, the first step, is done with a powdered Colmonoy alloy, using the Spraywelder. Fusing the sprayed Colmonoy overlay with an oxy-acetylene flame completes the Sprayweld Process. This forms an integral welded hard-facing.

Only Colmonoy hard-facing alloys can be sprayed and fused. Only Spraywelding can give you a smooth overlay that is welded to the part, free of pinholes, within .010" of desired size per side, and so quickly finish machined or ground.

Colmonoy No. 6, the alloy primarily used in Spraywelding, is a nickel-base alloy that stands at the top of its class. It has excellent corrosion resistance, thwarting the actions of most acids and alkalies. It resists abrasion and the effects of oxidation. It does not gall and has a low coefficient of friction, resulting in longer packing life. Applied with the Spraywelder, Colmonoy No. 6 can't be beaten for reclaiming your pump parts.

Take, for example, the hard-faced pump rod (from an acid sludge pump) shown here. Unprotected rods from the same pump had to be repacked every eight hours and replaced every 24 hours. New rods cost \$45, plus installation.

After reclaiming some worn rods with Spraywelded Colmonoy No. 6, the packing lasted sixty hours, eight times longer than before. The rods themselves lasted an average of 573 hours, 23 times as long as did the new unprotected rods. Sprayweld cost was half that of a new rod.

Pump plungers, pistons, seal rings, shafts, bushings, sleeves, and impellers, and valve parts are all benefited with longer life when Spraywelded with Colmonoy alloys.



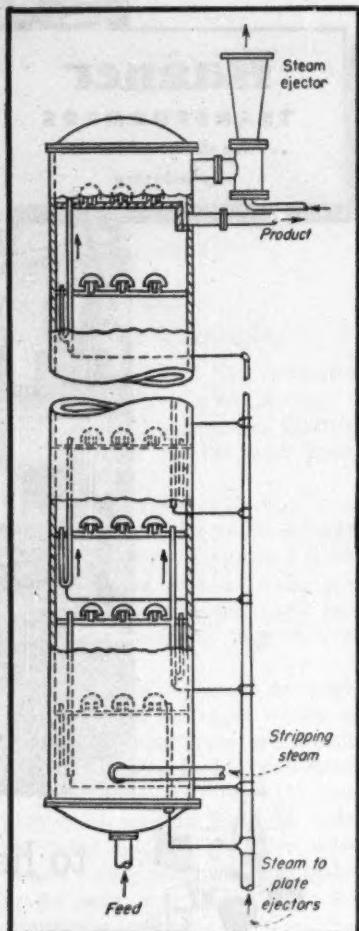
Write us for the name of the nearest shop doing Sprayweld work. Write, too, for Hard-Facing Manual No. 77. It gives the characteristics of all Colmonoy alloys, and typical jobs on which they are used; also full information on the Sprayweld Process. Engineering Data Sheet No. 3 lists the many acids and alkalies which Colmonoy nickel-base alloys will resist. Write today!

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### Continuous Oil Deodorizer Uses Concurrent Flow

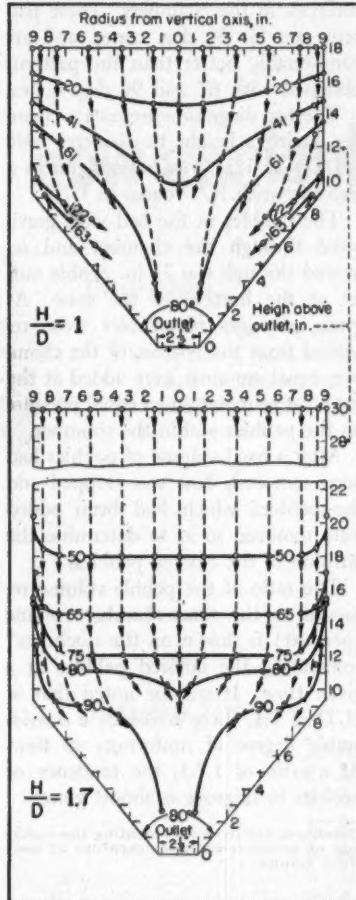
A novel bubble-cap column for deodorizing animal and vegetable oils utilizes upward flow of liquid from plate to plate. The apparatus is described in U. S. 2,615,833, by Dion K. Dean and Francis B. White, assigned to Foster Wheeler Corp.

The usual continuous deodorizer is a countercurrent bubble-cap stripping column operated under vacuum, with oil flowing down and stripping steam flowing up. Vacuum is applied at the top of the column, and since there is a substantial pressure drop per plate, the absolute pressure at the bottom of the tower is higher than at the top. This causes the lower section of the column to be inefficient due to a decreased volume of stripping steam.

In their invention, Dean and White assume that deodorizing is simply a process of contacting steam thoroughly with oil, not fractional distillation. If this is correct, countercurrent opera-

tion is unnecessary, and thorough contacting of steam and oil can best be obtained by concurrent flow.

► How It Works—Both steam and oil enter at the bottom of the tower and move upward, contacting each other on a series of bubble plates. The liquid is carried up from plate to plate by means of individual steam ejectors (see cut). The main stripping steam flows upward through the bubble caps on each plate in the normal way. Aside from the steam fed to each ejector, the operation is concurrent.



### Latest Pebble Heater Design

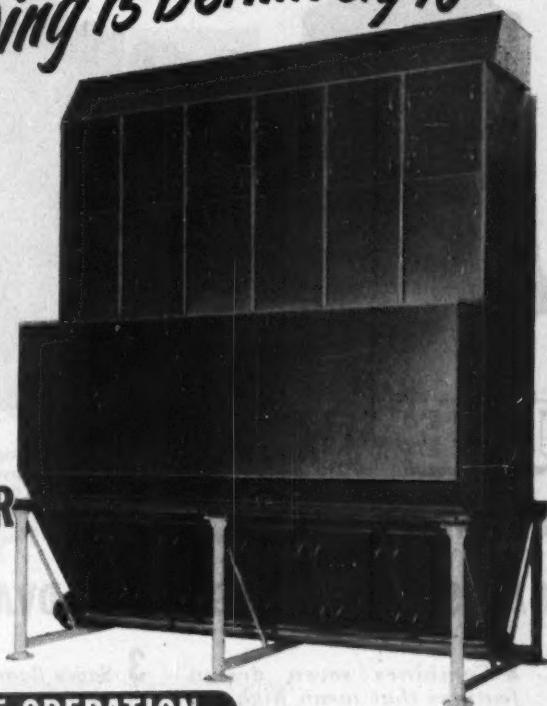
Processes which are carried out in pebble heat exchangers utilize a flowing mass of solid heat exchange material which passes downward by gravity through a chamber, countercurrent to a mass of rising gas at a different temperature. Conventional pebble heaters are generally cylinders with a single outlet at the bottom.

A serious disadvantage of this equipment is the lack of uniformity of flow of pebbles across the cross-section of

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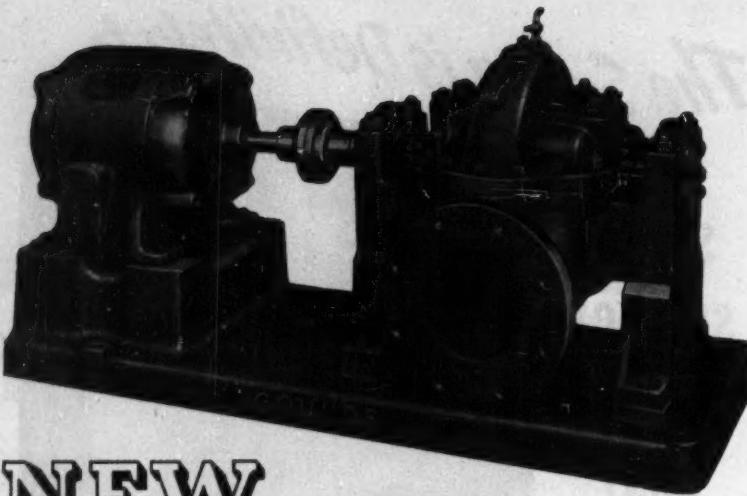
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# NEW GOULDS PUMP GIVES YOU 5 BIG COST ADVANTAGES

**GOULDS FIG. 3405** — Single stage, double suction centrifugal pump. Heads to 260 ft. Capacities to 6400 ft. For general purpose pumping.

**1 Combines seven design features that mean high operating efficiency and low maintenance.**

Every one of the following construction features is standard with this new design:

- Renewable stuffing box bushings.
- Bearing housings sealed against moisture and dirt.
- Cowl-type glands suitable for use with quenching liquid.
- Stainless-steel impeller keys.
- Teflon water-seal rings.
- Die-formed stuffing box packing.
- Corrosion-resistant gland bolts.

**2 Interchangeability of parts.**

Only three shafts and rotating parts assemblies provide for 19 pump sizes. This means you get:

- Great flexibility in making field changes.
- Low initial cost due to standardization of manufacture.
- Reduced spare parts inventories.

**3 Saves floor space.**

Short bearing spans cut over-all lengths as much as 50%.

**4 Flexibility of stuffing box.**

You can use either conventional stuffing boxes or mechanical seals—and change from one to the other.

**5 Easy rotation change.**

You can change from right-to-left-hand rotation or vice versa in the field without construction change because of an unique device locking shaft sleeves.

**GET FULL DETAILS** from the 12-page illustrated bulletin, No. 721.6, covering the complete details of the new Goulds Fig. 3405, including specifications, interchangeability tables and performance curves. Be sure you have the whole cost-advantage story before you select another general purpose pump. Contact your nearest Goulds representative or write to Goulds Pumps, Inc., Seneca Falls, N. Y.

TOMORROW'S TECHNOLOGY, cont. . .

the chamber, particularly in relatively shallow chambers.

Louis C. Bearer now claims that the optimum design of such chambers involves the use of a bottom cone having an 80 deg. angle, and with its height at least as great as the diameter of the chamber. He has assigned his invention, U.S. 2,625,377, to the Phillips Petroleum Co.

A series of flow patterns is presented in the patent, two of which are shown here. In preparing the diagrams, colored pebbles were placed at spaced intervals in the chambers. These patterns are for 80 deg. cones, and are considerably better than the patterns obtained with 67 and 90 deg. cones.

The top diagram represents a chamber having a height to diameter ratio (H/D) of 1:1. The lower figure is a chamber with H/D equal to 1.7:1.

The pebbles in the bed were gravitated through the chamber and removed through the 2½ in. pebble outlet at the bottom of the cone. As given amounts of pebbles were removed from the bottom of the chamber, equal amounts were added at the top so as to maintain an equal pressure on the pebbles within the chamber.

After a fixed volume of pebbles had been removed, flow was stopped and the pebbles which had been added were removed so as to determine the position of the colored pebbles.

The ratio of the pebble volume removed to the total chamber volume (percent) is shown on the isochores\* connecting the colored pebbles at a given time. It will be noted that at H/D of 1:1, there is already a considerable degree of uniformity of flow. At a ratio of 1.7:1, the tendency of pebbles to stagnate is almost gone.

\*Isochores are lines representing the variation of pressure with temperature at constant volume.

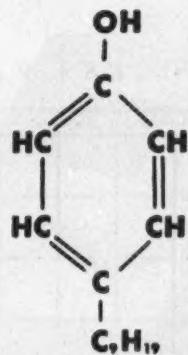
## Variable-range Rotameter

George R. Gilbert has assigned to Standard Oil Development Co. a means for varying the range of a given rotameter. This is accomplished by adding magnetic weights to the top of the rotameter float by hand manipulation of an external magnet.

The weights are stored in the upper part of the flow tube, above the calibrated section. Thus, you don't have to open the rotameter when changing the range. The invention is described in U. S. 2,618,974.



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Color, Pt-Co scale	200
Refractive index, 20°C	1.5140
Flash point (TOC), °F	300
Pour point, °C	2
Distillation range, °C	
IBP	290
5 ml.	293
95 ml.	297
EP	301

*Suggested Uses:*

1. An intermediate for non-ionic detergents
2. A stabilizer for ethyl cellulose
3. A plasticizer for cellulose esters
4. An intermediate for other plasticizers
5. A starting material for production of lubricating oil additives and rubber chemicals
6. An antioxidant

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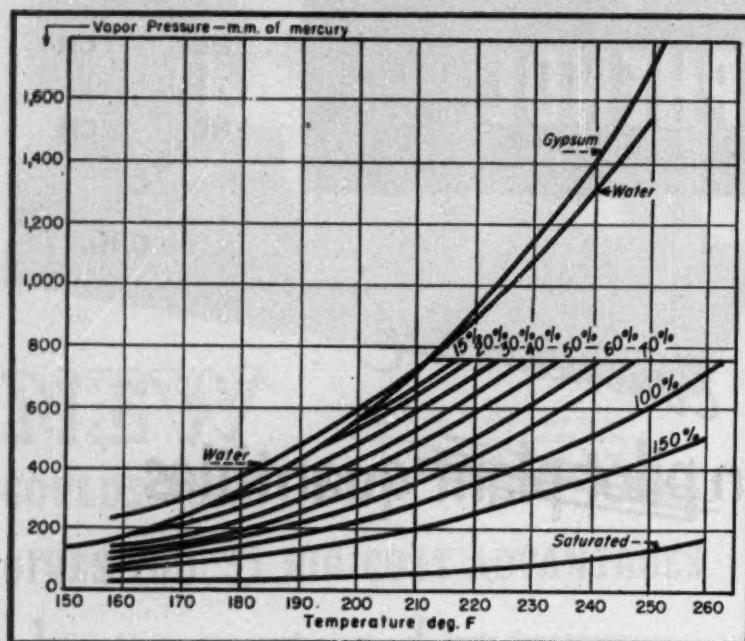


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PROCESS PATENTS



## Stronger Gypsum Plaster

New wet process for calcined gypsum imparts increased strength and density to finished product. Uses water solutions of metallic salts as vapor pressure depressants.

Calcined gypsum, as it's normally made in a calcining kettle, needs a relatively large amount of water to give a given consistency. If you can reduce the amount of water used to produce a mortar, you will increase both the strength and the density of the resulting cast or set product.

Now, Gilbert A. Hoggatt has devised a wet calcination process for the production of calcium sulphate hemihydrate plaster which uses much less water than conventional methods. It is described in U. S. 2,616,789 and assigned to Certain-Tee Products Corp.

► How It Works—Gypsum is heated in

an aqueous solution of a vapor pressure depressant—a metallic salt—at atmospheric pressure. The reaction is  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} = \text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + 3/2\text{H}_2\text{O}$ . (1)

Thus, gypsum exerts a vapor pressure of water. The accompanying figure presents the water-vapor pressure curve of gypsum as a function of temperature.

It also gives curves for the vapor pressure of water from various aqueous solutions of calcium chloride. The concentrations are expressed as percentages, by weight, of calcium sulphate referred to water.

The intersection of the vapor pressure-temperature curve of gypsum with

that of the salt solution indicates the "inversion temperature." At temperatures higher than this, the vapor pressure of gypsum is greater than that of the salt solution. Hence, the "escaping tendency" of water is greater for gypsum than for the salt solutions, and reaction (1) takes place.

Below this temperature, the reaction tends to be reversed. Thus, in order for the desired reaction to occur, it is only necessary that you exceed the inversion temperature.

To get satisfactory results, though, you have to control the rate of reaction. This is done by maintaining the proper vapor pressure driving force.

At a given temperature, the difference between the vapor pressure of gypsum and that of the salt solution is a measure of the speed of conversion from calcium sulphate dihydrate to the hemihydrate.

► Crystal Structure—If this difference in vapor pressures is too great—so that conversion goes too fast—the crystals of hemihydrate will be long and needlelike and will require a large amount of water to reach the pouring consistency.

Smaller differentials will cause the production of thick, stubby rod-like crystals having a low water-carrying capacity. If the differential is too small, however, the rate of conversion will be too slow to be practical.

The range of satisfactory vapor pressure differentials is 150-1000 mm. Hg, with 170-450 mm. being optimum. The appropriate temperature range for a given concentration of calcium chloride can be found directly from the accompanying figure.

As a matter of convenience, it is desirable to operate at the boiling point of the solution, providing this is in the allowable temperature range. This eliminates the need for precise temperature control.

If the upper temperature limit for a given salt solution is above the boil-

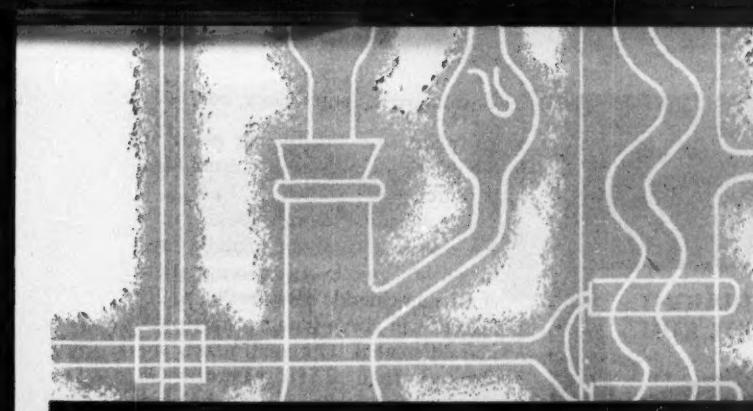
Table I—Operating Temperatures for  $\text{CaCl}_2$  Solutions

$\text{CaCl}_2$ , %	Min. Temp. at 150 mm., °F.	Max. Temp. at 1000 mm. or Boiling, °F.	Max. V.P. Diff. at Boiling, mm.
20	219.5	219.5*	150
30	213	224*	245
40	204	229*	360
50	194	235*	510
60	186	241.5*	600
70	181	248*	880
100	175	246*	1450
120	168	238*	2770

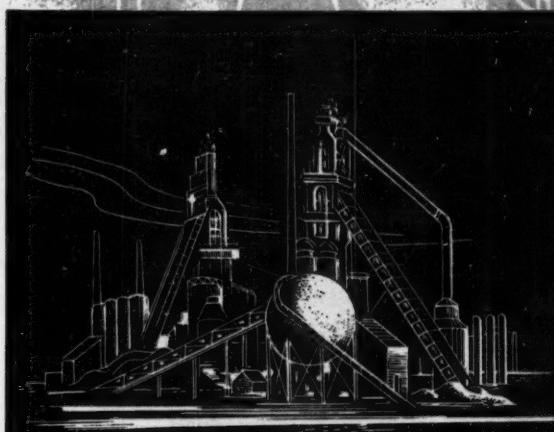
\*at boiling † below boiling

Table II—Results with  $\text{CaCl}_2$  Solutions at Boiling Temp.

	Boiling Temp., F.	V.P. Diff., mm.	Conversion Time, Hr. 8-barely started	Pouring Consistency	Types of Crystals
	217	110			
			3/4	45	mostly rodlike
			2 1/2	45	mostly rodlike
			2 1/2	48	largely rodlike
			—few needles		
			largely rodlike		
			—some needles		
			largely needles		
			mostly needles		



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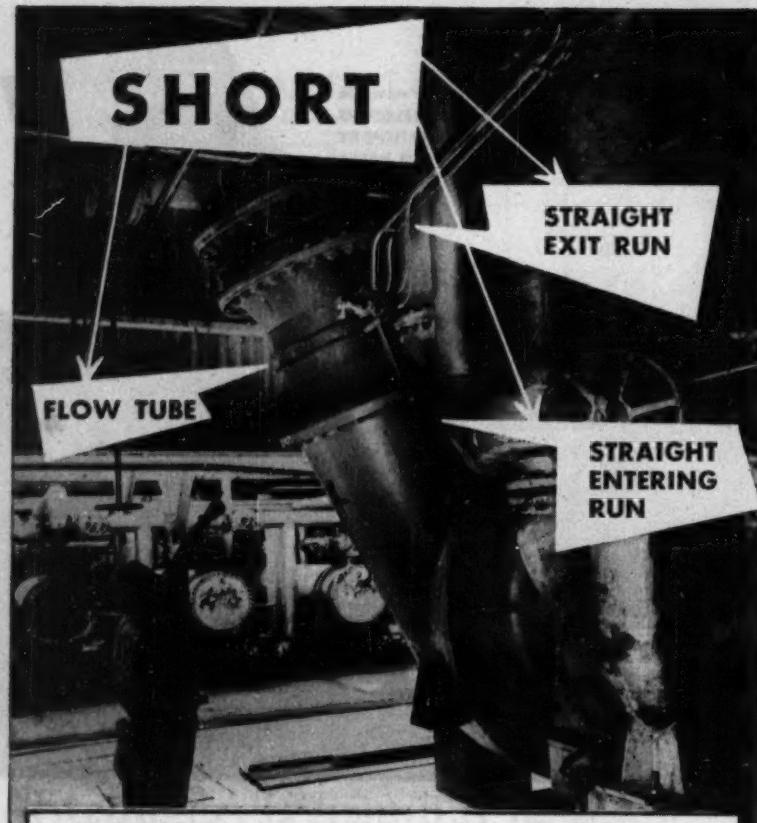
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#### TOMORROW'S TECHNOLOGY, cont. . .

ing point, use the boiling point as the practical upper limit to avoid high pressures.

The operating temperatures for various calcium chloride solutions are shown in Table I. Any concentration of calcium chloride between 20 and 70 percent will give a suitable vapor pressure differential. Optimum results are obtained from 22-48 percent. Of course, many other salts can be used successfully.

The results of using various calcium chloride concentrations at their boiling points are given in Table II.

► **Best Operations**—The preferred method when using calcium chloride is to adjust the concentration so that the boiling point is 225-230 deg. F. at atmospheric pressure. This corresponds to about 30 to 45 percent calcium chloride.

Boiling is continued until the gypsum is substantially converted to the hemihydrate—2½ to 3 hr. During the reaction, the solution tends to be diluted by the release of water of crystallization but concentrated by the evaporation of water. Additional salt or water can be added to keep the boiling point at the desired temperature.

When the conversion to hemihydrate is completed, the product is washed in boiling water. The temperature of the hemihydrate must be kept above 212 deg. F. during washing or it will tend to rehydrate.

Drying is then carried out at temperatures above 212 deg. F. but below 350 deg. F. since further dehydration to the anhydrite occurs at higher temperatures. The dried product is ground to desired fineness. The setting takes 5-25 min., but retarders or accelerators can be used to control this time.

Any salt can be used as a vapor pressure depressant. It's advantageous to use calcium chloride, though, since it doesn't react chemically with calcium sulphate and thereby eliminates the formation of complex salts.

The patent specifies that a plant for the production of large batches on a commercial scale is now operating. The product is claimed to be superior to that obtained in the laboratory. Its pouring consistency is 32-33, compared to about 70 for kettle-calciined gypsum plaster normally produced. The tensile and compression strengths at 33 water/plaster ratio are 1,050 and 9,100 psi., respectively.

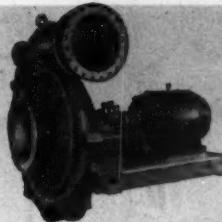
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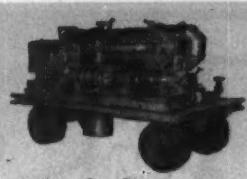
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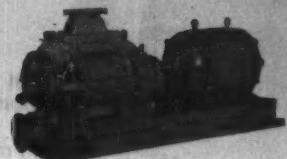
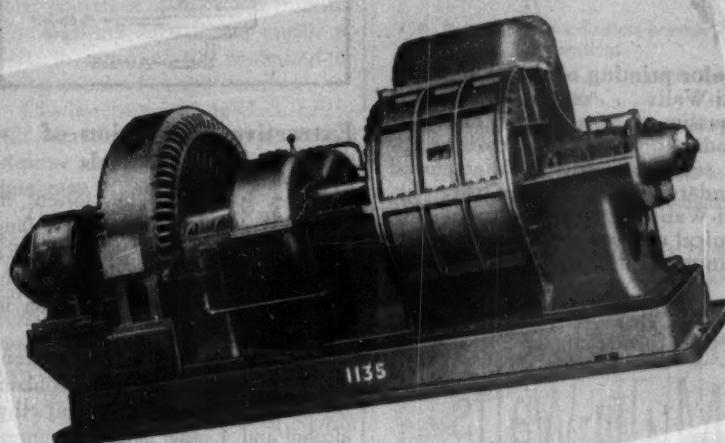
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TOMORROW'S TECHNOLOGY, CONT. . .

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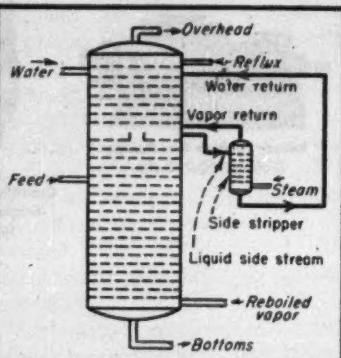
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### Extractive Distillation of Close-Boiling Alcohols

Water is used as the solvent in extractive distillation of close-boiling alcohols. In this process, the relative volatilities of the alcohols vary considerably with their concentration in the solvent.

For example, with 92 mole percent water in a refluxing medium containing in solution 96 mole percent ethyl alcohol and 4 mole percent isopropyl alcohol, the relative volatility of the isopropyl to the ethyl is 1.7. When the concentration is 4 mole percent ethyl alcohol and 96 mole percent isopropyl, the relative volatility is only 1.5.

This means that it is harder to remove the last few percent of ethyl alcohol from isopropyl alcohol than it is to remove the last few percent of isopropyl from ethyl. That is, purified ethyl alcohol in dilute aqueous solution is readily recovered as bottoms but the isopropyl alcohol tends to be contaminated with ethyl alcohol. Increasing the water concentration overcomes this, but it also causes excessive dilution of the ethyl alcohol.

In U. S. 2,620,294, by Carl S. Carlson, assigned to Standard Oil Development Co., this difficulty is overcome by maintaining a higher concentration of water at the top of the distillation column than at the bottom.

This is accomplished by steam stripping a side stream nearly free of alcohols (see cut). Water is taken from the bottom of the stripper and returned to the top of the distillation tower.

Thus, it is possible to maintain a water concentration of 97 mole percent in the upper part of the column to remove the last few percent of ethyl alcohol from the isopropyl alcohol. A

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water concentration of 92 mole percent is maintained at the bottom.

This technique is also useful in other cases, such as separating sec-butyl alcohol from n-propyl alcohol.

### New Way to Winterize Vegetable Oils

To winterize a vegetable oil, you have to freeze out the stearines and then filter them from the clear oil. The separation of the solids from the liquid is very difficult and usually results in much of the winterized oil being entrained in the stearines.

Charles Greenfield, in U. S. 2,619,421, describes the formation of hard stearine crystals which occlude a minimum of oils.

The process starts at about 15 deg. above the "nuclei control point." This is the temperature at which crystal nuclei are considered as being formed. A method of determining this point—commonly near 50 deg. F.—is described in the patent.

The oil is cooled at a uniform rate for 18-48 hr. until the nuclei control point is reached. The temperature is then lowered uniformly—15-45 deg. F. per 24 hr.—to a temperature designated as the "crystallization point."

You then heat the oil—15-45 deg. F. per 24 hr.—until it reaches the "temperature rise point," thereby yielding "stabilized" crystals of the desired type. Rechilling is carried out at 5-15 deg. F. per 24 hr. down to the "rechill point," and the stearines are removed by filtering.

Ways to determine the proper values of each of the critical temperatures are described in the patent and examples of the obtainable results are cited.

### Hydrogenation Catalysts by Reduction

Here's a method of making active hydrogenation catalysts by the reduction of kieselguhr-supported copper or nickel compounds in a liquid medium comprising an organic polysiloxane. The copper or nickel compounds which are suitable are those which can be reduced by hydrogen to the active state—oxides, hydroxides or carbonates.

For example, 30 parts of a basic copper carbonate-kieselguhr are precipitated from a copper salt solution in the presence of kieselguhr by means of a potassium carbonate solution. It is washed until neutral, dried at 60

For Eye-Level Readings...

# AUTO-LITE

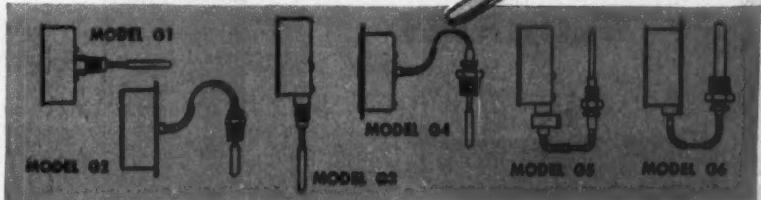
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a CAR UNLOADER

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**VERTICAL  
PUMPS**  
WITH  
**NO SUBMERGED  
BEARINGS**  
FOR PUMPING  
**ABRASIVE  
CORROSIVE  
SLURRIES**

2" Dual Discharge  
Pump for pumping  
molten caustic slurry.

Cross section of  
Dual Discharge  
Pump.

This rugged type of service calls for advanced design: — extra heavy shaft, double-ported casing to equalize the side thrust of the impeller, and tough abrasion-corrosion resistant alloys. The dual discharge pump illustrated here incorporates these features and dispenses with bearings or packing below the cover plate where they would be in contact with the liquid.

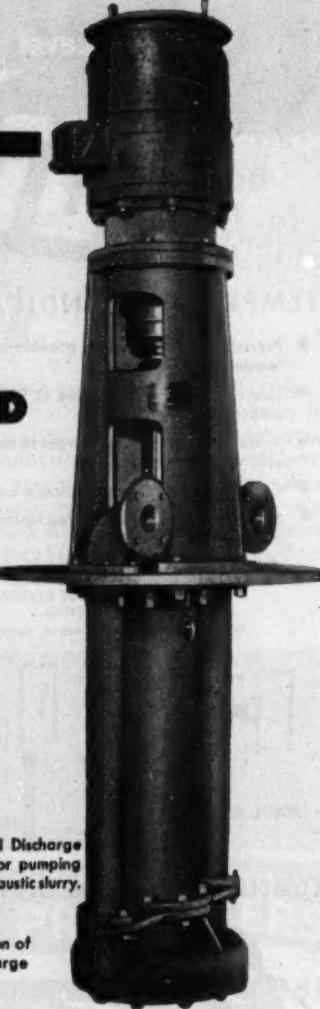
Difficult pumping problems, particularly in the process industries, have been our specialty for ninety-one years. Perhaps we can be of help to you. Write us — no obligation.

**LAWRENCE  
PUMPS  
INC.**

371 MARKET STREET, LAWRENCE, MASS.



Write for Bulletin  
203-6 for complete  
summary of acid  
and chemical pump  
data.



TOMORROW'S TECHNOLOGY, cont. . .

deg. C., and then dispersed in a medium of 250 parts of 2-ethyl hexanol and 10 parts of liquid polydimethylsiloxane and heated to 145 deg. C.

Hydrogen is passed through the stirred suspension for 6 hr., and the temperature is slowly raised to 165 deg. C. Loss of 2-ethyl hexanol is avoided by using a reflux condenser.

Four 100 part batches of  $\alpha$ -methylstyrene in isopropyl benzene (50:50 mixture) are then hydrogenated at 160 deg. C., using this catalyst suspension, without appreciable loss of catalytic activity. Complete reduction takes 2-3 hr. per batch. The hydrogenation products are distilled from the reaction medium, leaving an  $\alpha$ -methylstyrene content in the final product of less than 0.5 percent.

Thomas Bewley and Peter L. Bramwyche have assigned their invention, U. S. 2,623,078, to The Distillers Co., Ltd.

**New Process for  
Methyl Vinyl Ketone**

A new way to prepare methyl vinyl ketone from butene-1 is revealed in U. S. 2,623,073, by William G. Toland.

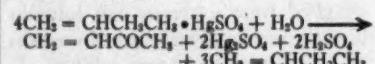
As an example of the method, a stream of butene-1 is passed into a stirred suspension containing 40 parts by weight of mercuric sulphate and 60 parts of a 1 percent aqueous solution of sulphuric acid at such a rate that the absorption of butene-1 is practically complete. The temperature of the reaction is maintained at 35 deg. F.

When this first reaction is complete, the products are transferred to a second reaction vessel in such a manner as to rapidly form, liberate and remove methyl vinyl ketone. To do this, the slurry is brought to boiling by adding the reaction products to 1,000 parts of stirred, boiling 10 percent sulphuric acid through which steam is passing. Thus, saturated ketone formation is avoided.

The first reaction is the formation of a complex:



The second reaction is the decomposition of the complex to yield the desired ketone:



Yields of the desired methyl vinyl

# STORAGE TANKS-

# plus!

Skilled design engineers demand superior products for their customers' use. And well they might! A.C.F. has the equipment, the techniques and the resources to shoulder a major responsibility, and deliver the goods. The shops are tooled for hand and machine-welding under precision control, for X-ray inspection as required, and with the personal skills and experience of as expert a staff as exists anywhere. We'd be delighted to discuss adding your firm name to the customer list. Write for literature.



Installation for this New York utility  
by H. Emerson Thomas and Associates, Inc.,  
of Westfield, New Jersey.

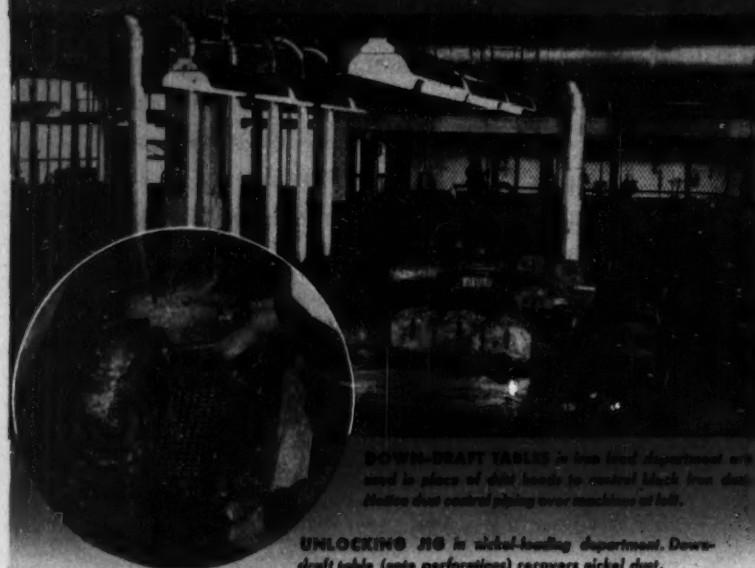
## a.c.f.

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# Pangborn Dust Control pays for itself in recovered material

at Thomas A. Edison, Incorporated



**DOWN-DRAFT TABLE** in iron-lead department now used in place of dust hoods to control black iron dust. Notice dust control piping over machines at left.

**UNLOCKING JIG** in nickel-loading department. Down-draft table (note perforations) recovers nickel dust.

**M**ANUFACTURING nickel-iron-alkaline storage batteries at Thomas A. Edison, Incorporated, creates nickel, nickel-hydrate, and iron-oxide dusts. Control and recovery of these valuable dusts was complicated by their light weight, which in some processes prevented the use of regular dust-collecting hoods. Pangborn engineers solved this problem by utilizing down-draft tables in a unique dust control system geared to Edison's particular requirements.

**RESULTS?** The Pangborn system pays for itself in recovered dust alone. In addition, the dust-free atmosphere has improved working conditions in the plant. Although this Pangborn dust control system is a major installation, it was completed without loss of a single day's production!

**WHAT ARE YOUR DUST PROBLEMS?** Find out how Pangborn can help you. Mail the coupon below today for Bulletin 909-A.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

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STOPS THE DUST HOG from stealing profits

**PANGBORN CORPORATION, 2600 Pangborn Blvd., Hagerstown, Md.**

Gentlemen: Please send me a copy of Bulletin 909-A.

Name \_\_\_\_\_

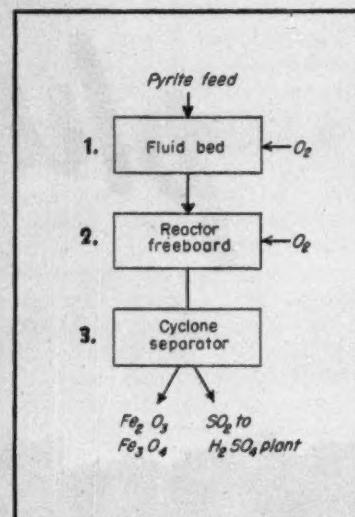
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## TOMORROW'S TECHNOLOGY, cont. . .

ketone and by-products under specified conditions are given in the patent which has been assigned to California Research Corp.



**1** FeS<sub>2</sub> roasted under fluidizing conditions. Oxygen added for roasting and fluidizing; controlled to leave 2 percent residual S in solids.

**2** Uprising gas contains SO<sub>2</sub> and S<sub>x</sub> and entrained iron-bearing compounds. These compounds react with and buffer the excess oxygen so as to prevent formation of SO<sub>3</sub>. Oxygen added to convert S<sub>x</sub> to SO<sub>2</sub>.

**3** SO<sub>2</sub> gas, now free of SO<sub>3</sub> and S<sub>x</sub>, together with entrained Fe<sub>2</sub>O<sub>3</sub> and Fe<sub>3</sub>O<sub>4</sub> is separated from entrained solids.

## Sulphuric Acid by Fluidized-bed Roasting of Pyrites

In U. S. 2,625,464, by Elliott J. Roberts, Rupert M. Foley and David F. Wells, assigned to The Dorr Co., a process is described for producing SO<sub>2</sub>, free of SO<sub>3</sub>, by roasting iron pyrites.

Use of the fluidizing technique makes it possible to suppress the premature formation of SO<sub>3</sub> in the roasting process. A flowsheet of the process is shown above.

## For Keeping Posted . . .

This digest of recently issued United States patents is selected and evaluated for you by Melvin Nord, 664 Putnam, Detroit 2, Mich. You can get copies of any patents, including those mentioned here, by ordering from the Commissioner of Patents, Washington 25, D. C. They cost 25¢ each. Do not send stamps.

# PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY

APRIL 1953



EXCHANGERS



THIN WALL  
ALLOY  
PIPING



CLAD STEEL  
VESSELS



CONDENSERS



FRACTIONATING  
TOWERS



PRESSURE  
PIPING



DIGESTORS



COOLERS

## Special Pre-Heater Monel-Protected Against Caustic

One unusual feature of a special exchanger now in the shops lies in the extensive use of corrosion-resistant Monel® for all parts which might come in contact with caustic soda.

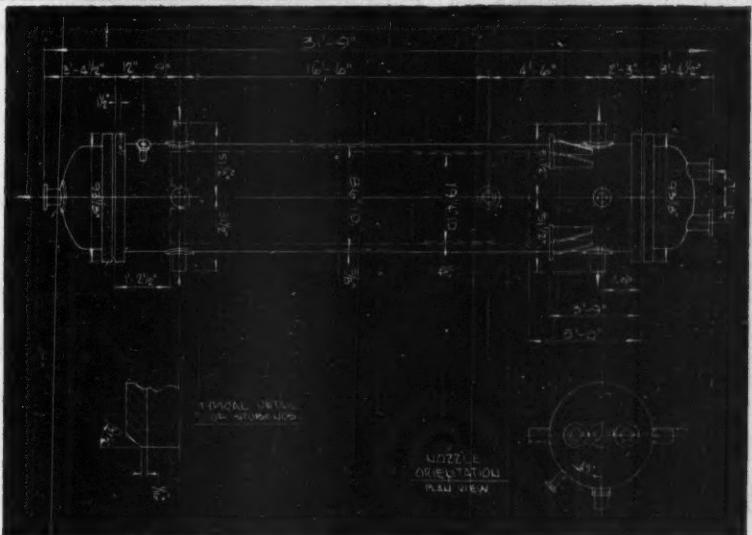
To be installed as a caustic pre-heater in an eastern seaboard refinery, the unit will have Monel tubes and Monel-clad tube sheets. Furthermore, the interior of the channels is protected by a cladding of Monel, while the heads are fabricated from castings of the same high-nickel alloy.

When in service, the exchanger will have 150-pound steam on the shell side which will raise the temperature of the caustic from 155° to 245°F. Twenty inches in diameter, the unit has 16-foot tubes of one-inch by 14-gage Monel. Cladding on the tube sheets is 15% of the overall thickness of the sheet.

® Trademark of the International Nickel Company, Inc.

## High Pressure Units for Sumatran Cracker

Six intercondensers for a renovated thermal cracker in Sumatra have just been designed by Kellogg's Fabricated Products Division. Made of alloy steel, they will operate at 1300 psi and 800°F, condensing tower overhead and pre-heating feed stock. Each condenser will measure 20-feet in length by four-feet in diameter, the shells being  $\frac{1}{8}$  inches thick.



## Synthetic Fibre Producer Gets Unusual Converters

Most heat transfer devices are designed so that tube bundles can be pulled at regular intervals for cleaning. However, Kellogg has just designed and is now fabricating a set of three synthetic fibre converters which have fixed internals. Special processing conditions, under which materials to be put through the shell side are previously treated,

prevents fouling of these sections of the converters. Specification of Stainless Type 340 tubes removes any danger of corrosion in the tube stream and also meets requirements of rather severe operating conditions—650°F and 250 psig. Largest of the three units will measure 23 feet long by 7 feet in diameter and weigh some 23 tons.

## Exchange Equipment by the Carload for Midwestern Refiner

Exchangers... condensers... coolers... reboilers by the score are in the design and fabrication stages at Kellogg for two locations operated by the same mid-western refiner. Including a multiplicity of various sizes—ranging from 13 inch-124 sq.ft. debutanizer reboilers to 39 inch-13,000 sq.ft. fractionator overhead condensers—the order includes both equipment for new processing units as well as replacement bundles for existing equipment which is being modernized. This job demonstrates the flexibility of Kellogg fabricating facilities in which orders for one cooler or a hundred AEC exchangers are processed to the highest quality standards.



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PRODUCTS DIVISION

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COMPANY

225 Broadway, New York 7, N. Y.  
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St. Louis, Tulsa, Montreal, Toronto,  
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PULLMAN

# Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Crystallization . . .	Evaporative crystallizer . . .	Phillips Petroleum Co.	2,623,814
Drying . . .	Rotary dryer . . .	Baker Perkins, Inc.	2,624,124
Evaporation . . .	Salt drying and cooling apparatus . . .	Clinton S. Robison	2,624,955
Extraction . . .	Air dryer . . .	Independent Engineering Co.	2,625,237
Filtration . . .	Continuous centrifugal evaporator . . .	La Cellulose du Pin . . .	2,625,580
Fluid and particle transfer . . .	Falling film evaporator . . .	Zaremba Co.	2,624,401
Gas absorption . . .	Multistage countercurrent extraction centrifuge . . .	Westfalia Separator AG	2,622,796-7
Gas-solids separation . . .	Perforated plates for liquid-liquid extractor . . .	Standard Oil Development Co.	2,622,968
Heat exchange . . .	Liquid-liquid contacting tower . . .	Universal Oil Products Co.	2,623,813
Instrumentation and control . . .	Horizontal plate filter . . .	Aloysius C. Kracklauer	2,624,465
Mixing . . .	Gas lift for granular material . . .	Houdry Process Corp.	2,625,442
Reactors . . .	Oil-bath type gas scrubber . . .	The Fluor Corp.	2,625,383
	Electrical precipitation of dust from hot gases . . .	Koppers Co., Inc.	2,625,238
	Centrifugal separator . . .	The Thermix Corp.	2,625,240
	Tubular heater for chemical reactors . . .	Universal Oil Products Co.	2,622,853
	Refrigerating heat exchanger . . .	Mills Industries, Inc.	2,622,854
	Liquid-gas finned heat exchanger . . .	Pierre G. Vicard.	2,622,857
	Heat exchange pebble . . .	Norton Co.	2,624,556
	Wet-dry bulb determination of vapor concentration . . .	Jerry Malecki.	2,623,391
	Dew point hygrometer . . .	The George W. Borg Corp.	2,624,195
	Gyrosopic flowmeter . . .	Sun Oil Co.	2,624,198
	Hot-wire flowmeter . . .	Myron H. Boyer	2,624,199
	Liquid flow indicator . . .	Albert Wittlin	2,624,308
	Flow control by balanced magnetic forces . . .	Esther C. Goddard and The Guggenheim Foundation	2,624,360
	Rheometer . . .	Armstrong Cork Co.	2,625,034
	Fluid contact apparatus . . .	Edwin G. Gettina.	2,622,859
	Solid catalyst injector . . .	Phillips Petroleum Co.	2,622,935
	Hydrocarbon cracking reactor . . .	Universal Oil Products Co.	2,622,969
	Method for gasifying solid fuels . . .	Standard Oil Development Co.	2,622,973

## ... And New Process Patents

Product or Process . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Air products . . .	Separation of air by low-temperature rectification . . .	Union Carbide and Carbon Corp.	2,619,810
	Separation of air with a single column . . .	The British Oxygen Co.	2,619,813
	Fractional distillation of air . . .	Air Products Inc.	2,620,637
	Removal of water and CO <sub>2</sub> from air . . .	Standard Oil Development Co.	2,622,416
Hydrocarbons . . .	Hydrogenolysis of heavy hydrocarbon residues . . .	Phillips Petroleum Co.	2,619,450
	Catalytic production of aldehydes and alcohols . . .	Stainless Steel & Iron Co.	2,619,506
	Production of high mol. wt. unsaturates . . .	Richard Conrad.	2,619,511
	Polymerization of propylene to liquid hydrocarbons . . .	Shell Development Co.	2,619,512
	Separation of gaseous hydrocarbons by distillation . . .	The Lummus Co.	2,619,814
	Selective adsorption of hydrocarbons . . .	Standard Oil Development Co.	2,620,047
	Cracking stock from hydrocarbon oil residues . . .	Phillips Petroleum Co.	2,620,293
	Catalytic oxidation of olefins with CuO . . .	Shell Development Co.	2,620,358
	Catalytic conversion processes for hydrocarbons . . .	Standard Oil Development Co.	2,620,361
	Catalytic removal of sulphur from hydrocarbons . . .	E. I. du Pont de Nemours & Co.	2,620,362
	Adsorption separation of normal from isoparaffins . . .	Standard Oil Development Co.	2,620,363
	Olefin polymerization with boron phosphate . . .	Atlantic Refining Co.	2,620,364
	Heavy hydrocarbon selective absorption from gas . . .	Hudson Engineering Corp.	2,620,895
	Nitration of olefins . . .	Union Oil Co.	2,621,205
	Production of ethylene . . .	Shell Development Co.	2,621,216
	Anthracene, phenanthrene and carbazole separation . . .	De Directie Van De Staatsmijnen in Limburg	2,622,087
	Desulphurization of a hydrocarbon oil . . .	Gulf Oil Corp.	2,623,006
	Catalytic desulphurization of hydrocarbons . . .	Phillips Petroleum Co.	2,623,007
	Caustic treatment of sour hydrocarbons . . .	Phillips Petroleum Co.	2,623,008
	Particulate coal carbonization to form olefins . . .	E. I. du Pont de Nemours & Co.	2,623,011
	Isomerization of saturated hydrocarbons with H <sub>2</sub> SO <sub>4</sub> . . .	Standard Oil Co. (Ind.)	2,623,076
	Removal of H <sub>2</sub> S from hydrocarbons . . .	Phillips Petroleum Co.	2,624,694
	Manufacture of carbon black . . .	J. M. Huber Co.	2,625,466
	Metal plating—atomizing a liquefied metal compound . . .	The Commonwealth Engineering Co. of Ohio	2,619,433
	Depression of copper sulphides in froth flotation . . .	American Cyanamid Co.	2,620,068
	Froth flotation promoter . . .	American Cyanamid Co.	2,621,789
	Purification of pulp . . .	Rayonier Inc.	2,621,124
	Preparation of phenol-formaldehyde resin . . .	The Dow Chemical Co.	2,620,321
	Polymerization of styrene . . .	Monsanto Chemical Co.	2,620,330
	Preparation of sulphonated phenolic resins . . .	American Cyanamid Co.	2,621,164
	Condensation resins of halogenated benzene epds . . .	Sprague Electric Co.	2,621,168
	Shaping articles from an acrylonitrile polymer . . .	American Viscose Corp.	2,622,003
	Precipitating cellulose acetate in the form of thin, flat particles . . .	American Viscose Corp.	2,622,273
	Preparation of acid-soluble cellulose derivatives . . .	Hercules Powder Co.	2,623,041-2
	Processing of sulphur-vulcanizable materials . . .	Phillips Petroleum Co.	2,625,528
	Controlled polymerization for synthetic rubber . . .	Standard Oil Development Co.	2,625,538
	Water gas by partly carbonizing fluidized coal or coke—rest of particles used as cracking catalyst . . .	Standard Oil Development Co.	2,619,449
	Catalytic hydrogenation of CO . . .	M. W. Kellogg Co.	2,620,346
	Synthesis with two-stage coke gasification . . .	Standard Oil Development Co.	2,620,348
	Production of gaseous mixtures of CO and H <sub>2</sub> . . .	Texaco Development Co.	2,621,117
	Production of methanol from CO and H <sub>2</sub> . . .	Ernst Peukert and Friedrich Hilberath	2,621,202
	Adsorption of hydrocarbons from oxygenated epds . . .	California Research Corp.	2,621,203
	Reforming natural gas to produce synthesis gas . . .	Phillips Petroleum Co.	2,622,089
	Fluid catalytic process . . .	Standard Oil Development Co.	2,622,970
	Catalytic synthesis of liquid hydrocarbons . . .	Hydrocarbon Research, Inc.	2,623,057
	Catalytic synthesis . . .	Standard Oil Development Co.	2,623,058
	Oxo process for alcohol and gasoline production . . .	Standard Oil Development Co.	2,623,074
	Production of carbon black and by-product synthesis gas . . .	J. M. Huber Co.	2,623,811
	Production of synthesis gas . . .	Standolind Oil and Gas Co.	2,625,470
	Separation of oxygenated compounds with bisulphite adducts . . .	Standolind Oil and Gas Co.	2,625,560

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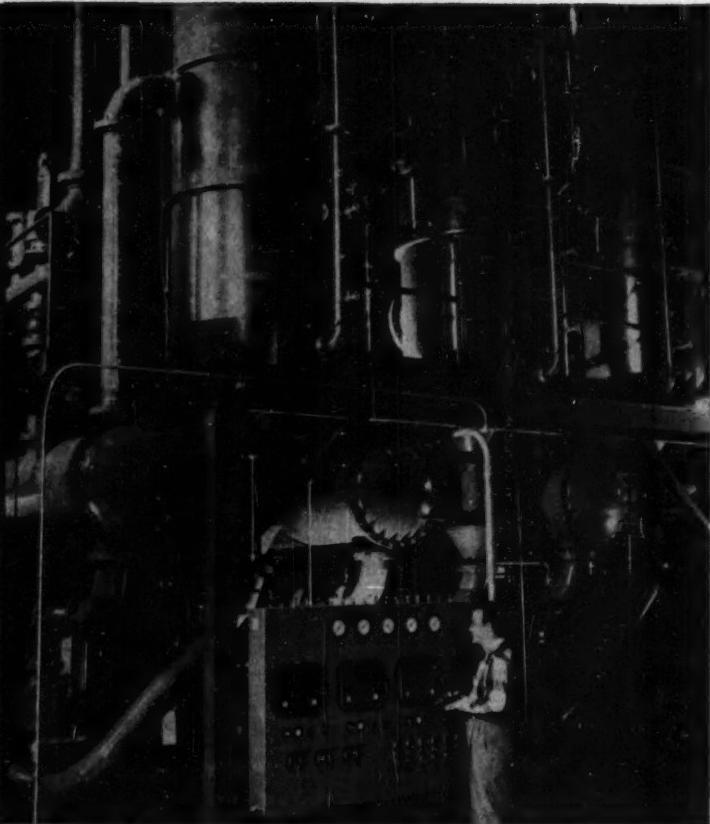
*New fractionating towers  
at our Mt. Pleasant plant.*



**ROOSEVELT** OIL AND REFINING CORPORATION  
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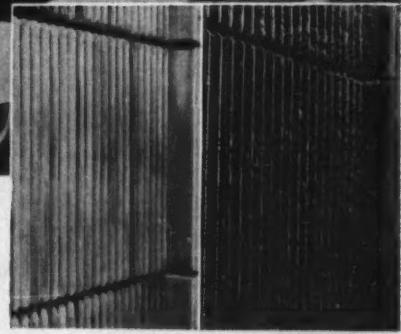
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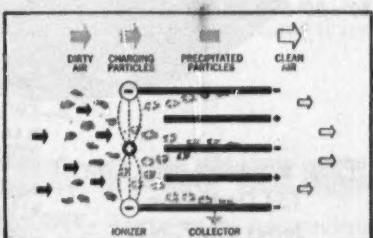
inghouse PRECIPITRON®, the electronic air cleaner. Five PRECIPITRON units work 'round the clock to remove dirt and germs.

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The Armed Forces need blood. Give a pint today!

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# **RACE IN THE 1980's**

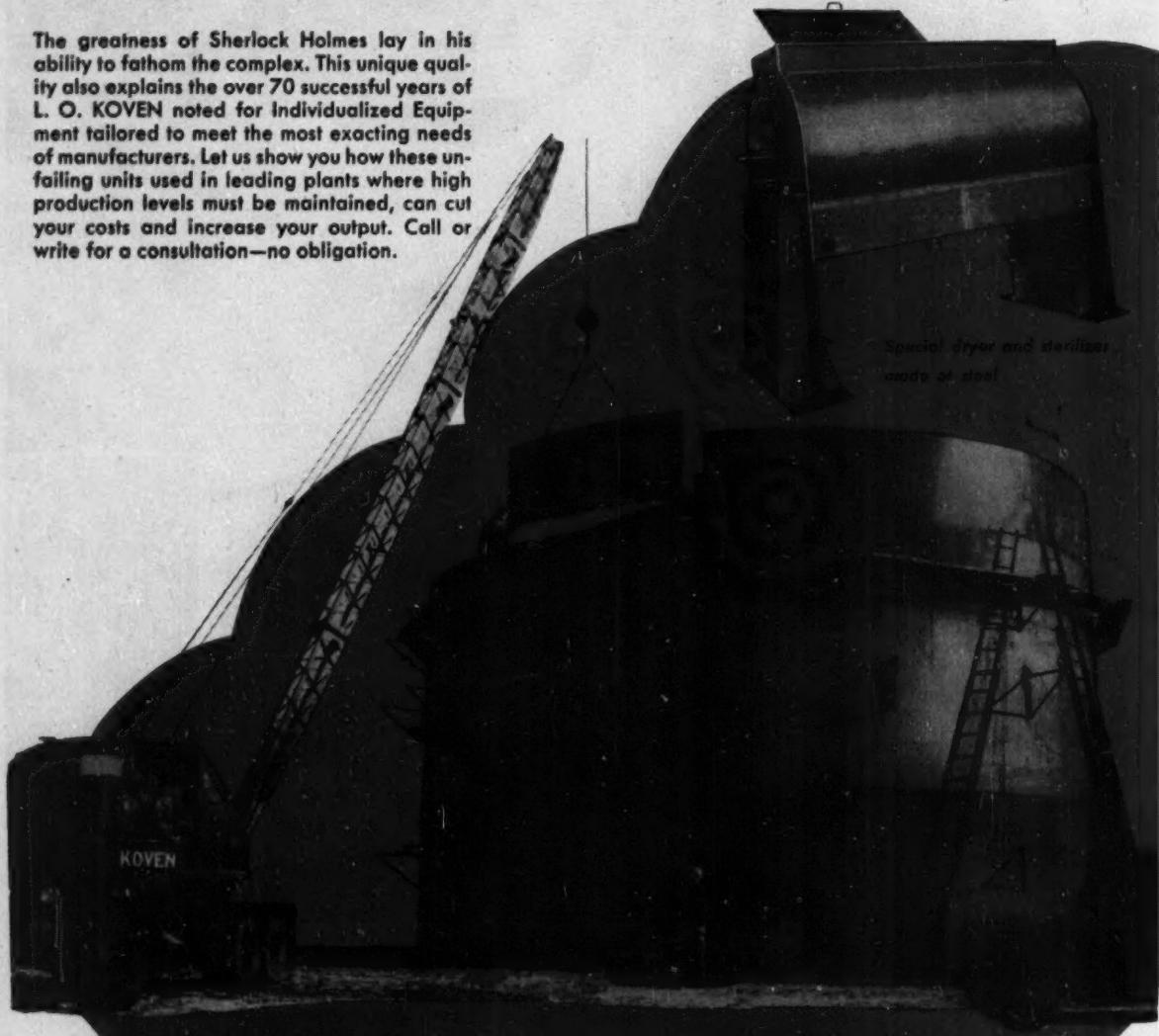
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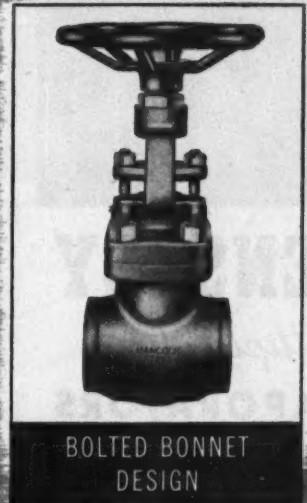
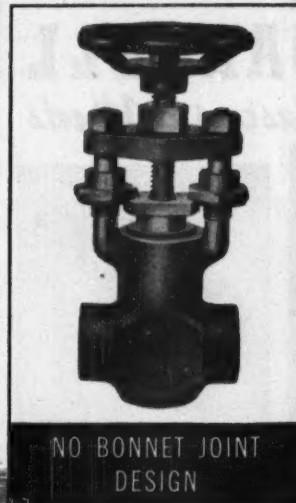
**Trenton, N. J.**



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*Choose*

THE TYPE YOU LIKE BEST



**800# GENERAL PURPOSE  
HANCOCK GATE STEEL WELDVALVES**

Extra years of trouble-free dependability. Long-life economy. 800# Hancock Steel Gate Weldvalves give you both. Select either "no bonnet joint" or bolted bonnet design — incorporated in them are exclusive construction and operational features that have proved their value in the severest services. Yet they cost no more than ordinary valves.

**Among the many superiorities built into these valves are:**

- 1. Maximum use of super-strong, leak-proof welding.
- 2. Integral Stellite seats.
- 3. "500 Brinell" stainless steel wedges.
- 4. No galling because dissimilar materials are used for the accurately finished and perfectly aligned seats and wedges.
- 5. No stem pitting.
- 6. Corrosion-resisting back seating.
- 7. Extra-strong upper structure.
- 8. Repacking ease.
- 9. Safe, comfortable handwheel — designed to operator specifications.
- 10. Complete interchangeability of parts that saves time, trouble, money.
- 11. Baked enamel exterior finish for maximum protection.

**SIZES:** No Bonnet Joint Design— $\frac{1}{4}$ " through 2". Bolted Bonnet Design— $1\frac{1}{4}$ " through 2".

**CONNECTIONS:** Screwed ends . . . socket weld ends . . . flanged ends.

**SERVICE RATINGS:** For all pressures up to 800 psi at 750° F.—O.W.G. 2000# 100° F.

Hancock Steel Gate Weldvalves do a job and stay on the job. Complete information about the type you like best is available through your Hancock Valve Distributor. Get in touch with him today.

**MANY ADVANTAGES ARE YOURS** through the complete services of your Industrial Distributor. He anticipates your needs—maintains stocks of many top-quality items —saves time and money for you with fast deliveries in emergencies.

**When Hancocks go in, valve costs go down.**

# HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.





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... your answer to

- INCREASED EFFICIENCY
- GREATER PLANT CAPACITY

If your processing requires evaporation or condensing operations, you will find a Henszey Multiple Effect Evaporator lowers production costs. They are fabricated of steel or stainless steel (either polished or unpolished finish) especially for the Chemical Industry.

Exclusive Henszey features include the re-use of waste vapor . . . automatic feed valves . . . full recovery of solids . . . elimination of foaming . . . PLUS savings up to 70% of the steam and 80% of ordinary water requirements.

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**HENSZEY COMPANY**  
DEPT. E-4, WATERTOWN, WIS.



Bottom doors swing open and all inside surfaces are "straight through" — clearly visible and easily accessible for swift, positive cleaning.

## HENSZEY

Also Power Plant Specialties including:  
CONTINUOUS BLOWDOWN • FEED WATER METERS • HEAT EXCHANGERS • INDICATING FLOW METERS  
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PROPORTIONING VALVES

For Savings  
Specify

## DARNELL Casters & Wheels



Whether for light, medium or heavy duty use, Darnell Casters and Wheels are built to take punishment.

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Built-in quality assures a long life of efficient service—it pays to "Demand Darnell Dependability".

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## STAINLESS Pipe & Tubing from stock

Large and varied stocks of stainless pipe and tubing are available for immediate shipment from Murray warehouse stocks. Sizes range from .125- to 8½-inch O.D. Sizes up to 24 inches O.D. can be supplied on special order.

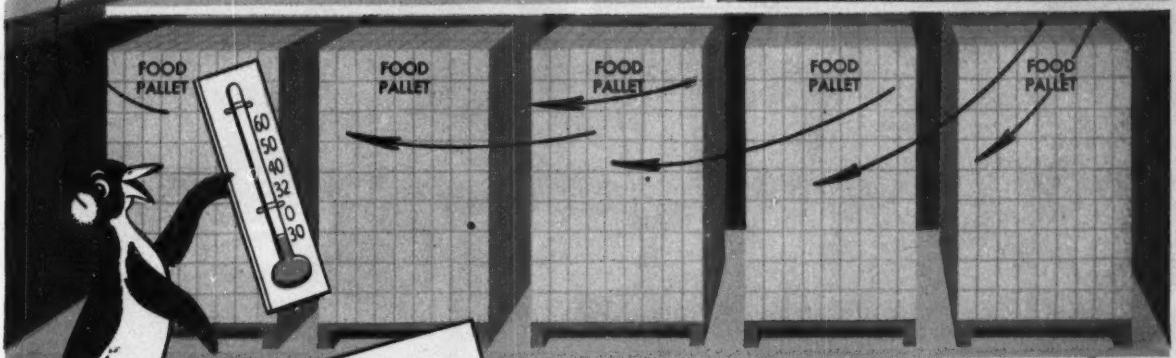
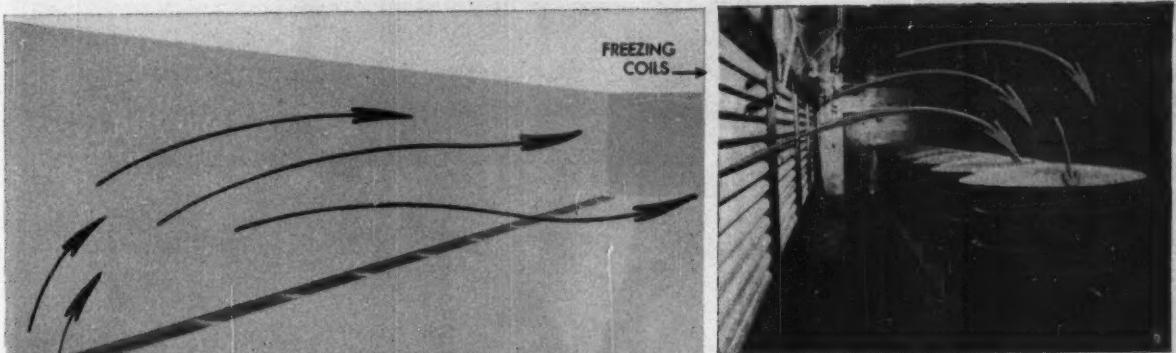
If you have a pipe or tubing problem the experience of our specialists and the research facilities of our suppliers are at your service.

Other Murray products include carbon steel tubing and pipe for pressure and mechanical purposes, welding and screw type pipe and tube fittings. Tube bending, upsetting, swaging.

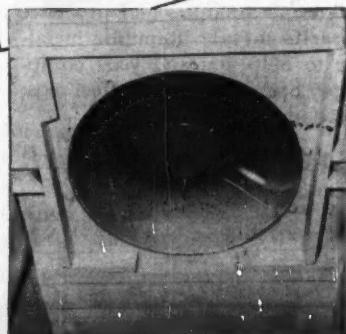


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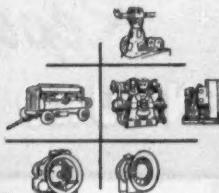
**JOY**  
®  
**AXIVANE FANS**  
**HANDLE SEVERE**  
**QUICK-FREEZE JOB**



Left: Looking up from the quick-freeze room below a Joy Axivane Fan. Note the compact, economical use of space and the simple mounting.

*Consult a Joy  
Engineer*

for Vaneaxial Fans . . . Compressors, Vacuum  
Pumps and Boosters . . . Oxygen Generators



WAD 1-4466

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SPECIALISTS IN THE COMPRESSION AND  
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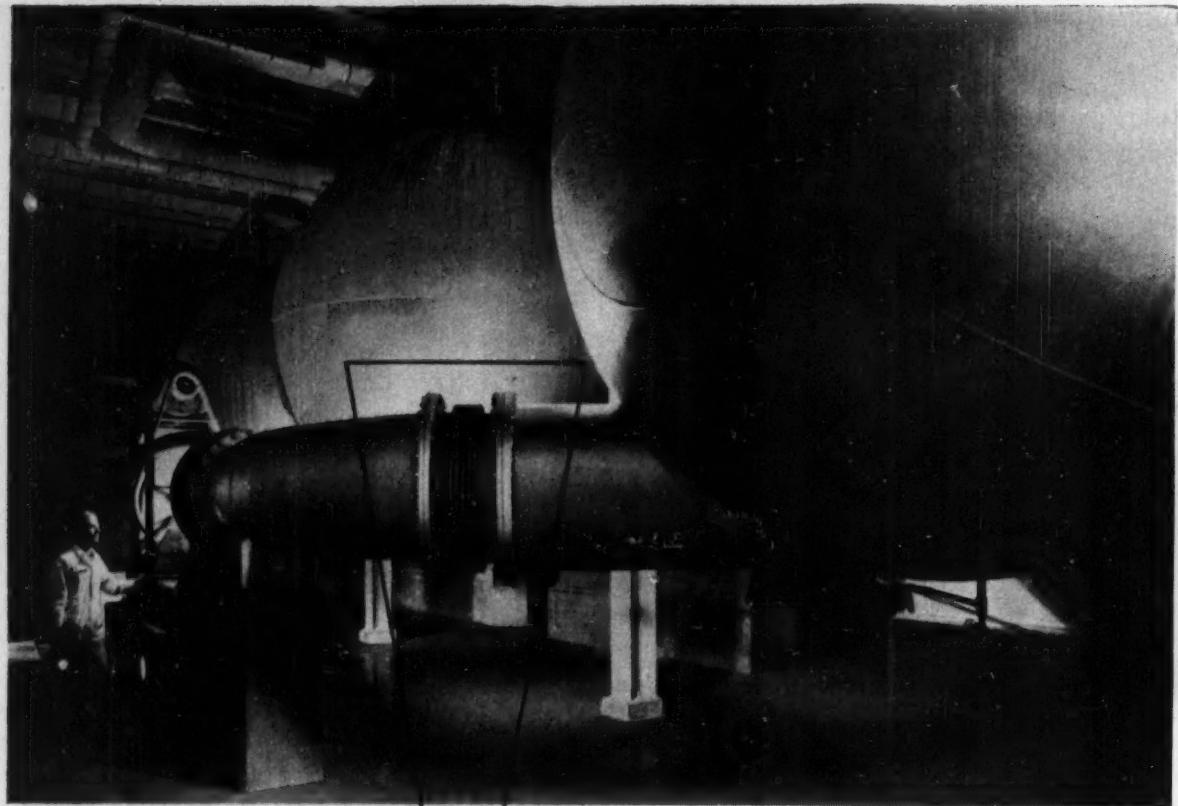


Photo courtesy Zallez Brothers, Wilmington, Delaware.

## SULPHITE HANDLING...

a job for corrosion-resistant *Enduro*

● Spelled "sulphite" or "sulfite," it's still mighty corrosive to most commercial metals. Except ENDURO Stainless Steel.

Built of ENDURO, eight expansion joints, each 36 inches in diameter—similar to the one shown—are installed in this piping which carries an acid mixture of sulphite wood pulp and cooking liquor. Not only must the flexible connectors be acid-resistant, they must also be durable and resilient.

In all types of process equipment, Republic ENDURO Stainless Steel resists the action of most acids and alkalies. It stubbornly fights off rust

and corrosion. It does not contaminate the products it handles. It maintains its great strength in scorching heat and in sub-zero cold. It lasts long.

What challenge do your products and processes have for this versatile metal? Republic metallurgists are ready to help you and your equipment suppliers apply ENDURO Stainless Steel most effectively and economically. Write:

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Alloy Steel Division • Massillon, Ohio  
GENERAL OFFICES • CLEVELAND 1, OHIO  
Export Department: Chrysler Building, New York 17, N.Y.

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**"THE STORY OF STAINLESS"**

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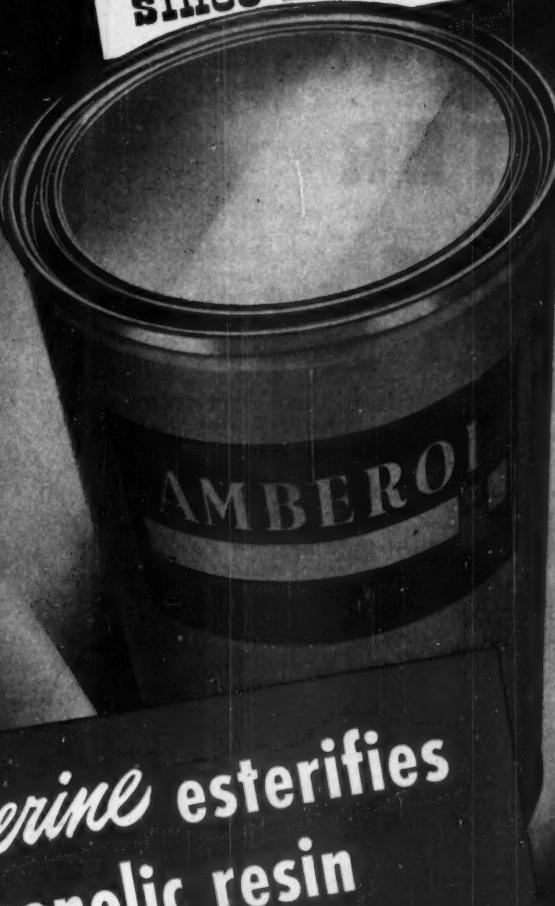
REPUBLIC

**ENDURO STAINLESS STEEL**



Other Republic Products include Carbon and Alloy Steels—Pipe, Sheets, Bolts and Nuts, Tin Plate, Tubing, Niles Barrels and Drums

since 1926...



AMBEROL

Glycerine esterifies  
phenolic resin

For over 25 years, Rohm & Haas has used Glycerine in the manufacture of its famous "Amberol F-7." This versatile modified-phenolic resin is used in floor varnishes, quick-drying enamels for home decorating and furniture refinishing, porch and deck paint, and marine finishes.

In the manufacture of Rohm & Haas' "Amberol F-7," a phenolic condensate reacts with Glycerine and rosin to yield a chemically and physically homogeneous, high molecular weight compound. Without this chemical combination with Glycerine and rosin, the phenolic condensate would be insoluble and could not be used in drying oils. Just one more example of the vital part Glycerine plays in the protective coatings industry.

In alkyd resin manufacture, too, America's leading paint manufacturers turn to Glycerine. They prefer its better cooking qualities. They know that Glycerine permits easy control of the manufacturing process to give a product of low acid number, without undue hazard of gelation.

If you'd like detailed information on Glycerine's chemical and physical properties write for your copy of "Why Glycerine for Alkyd Resins and Ester Gums?"—Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y.

*Nothing takes the place of Glycerine*

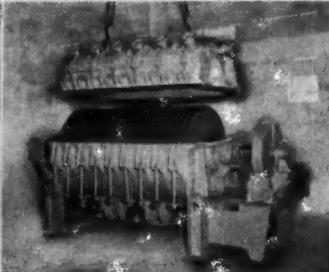
# GOSLIN-BIRMINGHAM

## Can Solve Your FILTER *Problem*

- **Totally enclosed vacuum filters for MEK dewaxing.**
- **Continuous pressure filters for propane dewaxing or chemical plant service.**
- **All types of rotary drum vacuum filters.**
- **Rotating leaf Vallez pressure type filters.**



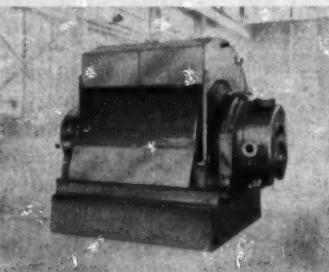
10' x 16' MEK dewaxing filter with 500 square feet effective surface.



Series 40 rotating leaf Vallez pressure filter, cast iron body, stainless steel element and cloth.



8' x 16' continuous pressure filter for propane dewaxing service.



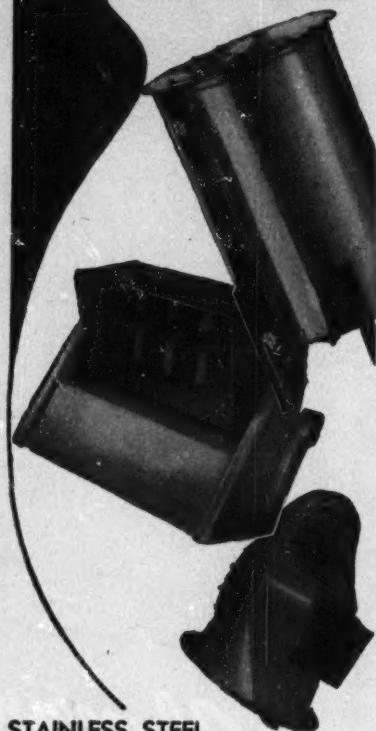
Continuous vacuum type salt filter of all Monel construction.

**GOSLIN-BIRMINGHAM**  
MANUFACTURING CO., INC.  
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PRECISION Fabrication

by

LITTLEFORD



### STAINLESS STEEL and ALUMINUM PRODUCTS...

are fabricated by Littleford to meet the demand for specialized equipment in the Chemical Industry.

To produce this exacting equipment takes experience and skilled craftsmen; this is where Littleford definitely fits into the picture. Since 1882 Littleford has developed craftsmen to lay out, shear, form and weld products of all descriptions. Tanks, (plain or code), Bins, Hoppers, Troughs, Vats, Covers, Tables, Special Parts and Sub-Assemblies.

Do not overlook the fact that Littleford takes a definite responsibility for the finished product and pride in quality fabrication; so if you have a problem involving Stainless Steel, Aluminum, or even Mild Steel send your blueprints to Littleford. See how experience and skill can produce low cost, quality products.

FABRICATORS  
OF  
PLATE AND  
SHEET METAL  
PRODUCTS  
FOR INDUSTRY  
SINCE 1882



**LITTLEFORD**

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April 1953—CHEMICAL ENGINEERING

(Advertisement)

**"THIS LUBRICANT  
EXTENDED  
BEARING LIFE  
50%"**

—says REPUBLIC AVIATION CORP.  
Makers of the famous F-84E THUNDERJET

"Under actual tests, LUBRIPLATE extended bearing life fifty per cent or better as compared to other lubricants. It was also found that, during test, LUBRIPLATE increased efficiency of machines twenty per cent by reducing friction loss. Republic has been using LUBRIPLATE successfully for the past eight years."

For nearest LUBRIPLATE distributor, see Classified Telephone Directory. Send for free 56-page "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

**REGARDLESS OF THE SIZE  
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ERY, LUBRIPLATE  
LUBRICANTS WILL IMPROVE  
ITS OPERATION AND REDUCE  
MAINTENANCE COSTS.**



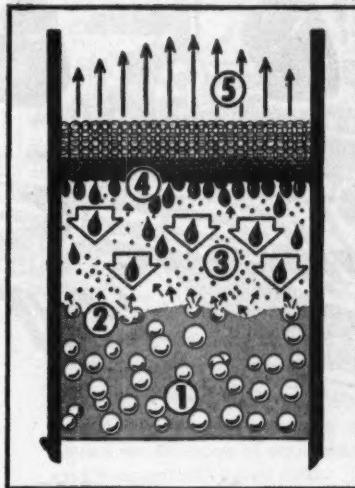
## Pads of Knitted Wire Mesh Wipe Out

### Liquid Entrainment

Removal of the liquid carry-over which is present in a wide range of processing operations is being secured, effectively and economically, by using pads made from multiple layers of knitted wire mesh.

These pads combine, within a few inches of depth, large wire surface area with an unusually high free volume—97 to 98%—made up of a multiplicity of unaligned asymmetrical openings. Installed within a vessel, these pads offer minimum restriction and pressure drop, yet it is impossible for a gas to pass through without continually changing direction and forcing impingement of the entrained liquid droplets upon the wire surface.

### How These Pads Work



A gas generated in or passing through a liquid (1), carries with it, as it bursts from the liquid surface (2), a fine spray of liquid droplets. These entrained droplets are carried upward by the rising gas stream (3).

As this gas passes through the pad, the droplets impinge on the extensive wire surface (125 square feet per cubic foot of pad volume). Droplets accumulate on the wire surface and form large drops of liquid which break away (4) from the wire mesh and fall back against the gas stream. The gas (5) passes on, freed from liquid entrainment. The liquid is returned.

### Availability

Since these pads, known as METEX MIST ELIMINATORS, can be knitted of practically any metal or alloy available in wire form, effects of corrosion can be minimized. A bulletin giving detailed information is available on request from the manufacturer, Metal Textile Corporation, Roselle, N. J.

## THIS BOOKLET

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**HELPS SOLVE  
YOUR  
FILTRATION  
PROBLEMS**

### Your Titeflex® Filter Booklet

is ready. Send for it now. Read about Titeflex Filters . . . their simple, fool-proof construction . . . simplicity of operation . . . efficiency . . . continuous economy in use and maintenance.

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is available, too, to consult with you on your filter problems. He'll help analyze your needs . . . select just the right equipment . . . give you the plain facts on costs.

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Please send me a copy of your Free Booklet about Titeflex Filters.

We need the advice of a Titeflex Filtration Engineer . . . without obligation on our part.

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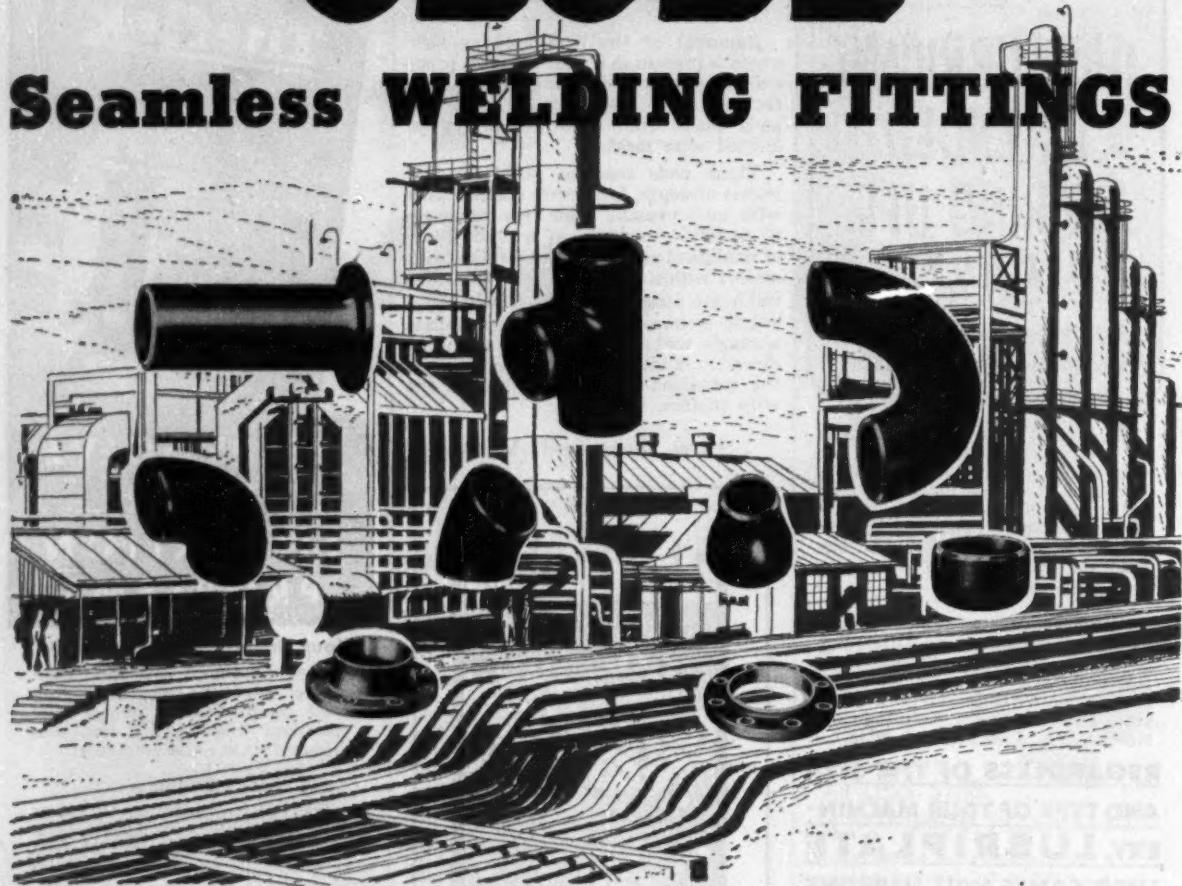
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# GLOBE

## Seamless WELDING FITTINGS



**The only seamless welding fittings  
precision-processed... from billet... to tube... to fitting**

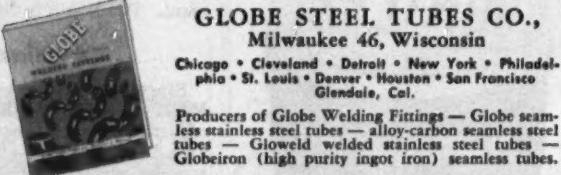


From charging the specially designed revolving furnace with a steel billet (above) through the many succeeding steps of production, every Globe process is specialized to produce fittings of unvarying quality.

Globe precision-process manufacture begins with the billet —continues through the making of the seamless steel tube (Globe alone among welding fittings manufacturers produces seamless steel tubes)—and extends through to the production of the finished fittings.

Because Globe has highly specialized controls—at every stage of manufacture at its own plant—you can be sure of uniform high quality seamless welding fittings when you specify Globe.

*Send for the Globe Welding Fittings complete catalog.*



Producers of Globe Welding Fittings — Globe seamless stainless steel tubes — alloy-carbon seamless steel tubes — Gloweld welded stainless steel tubes — Globeiron (high purity ingot iron) seamless tubes.

**AVAILABLE IN A COMPLETE LINE OF SIZES AND WEIGHTS  
THROUGH GLOBE DISTRIBUTORS IN ALL KEY CITIES**

**Rietz**

**specializes  
IN SIZE  
REDUCTION**

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**Disintegrators**

For fine or coarse grinding, pulverizing, pulping. 360° screen in wide variety of sizes. Patented differential discharge.

**Rietz**

**Prebreakers**

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**TL COOKERS:** continuous screw-conveyor steam blanchers. **TJ HEAT EXCHANGERS** for heating or cooling; batch or continuous.

Equipment for the food and chemical process industries



**MANUFACTURING CO.**

Santa Rosa, California



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By our two factories — New Haven and Salt Lake City — located to give you maximum service and minimum delay in shipment

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Order a trial quantity of made-up covers for your equipment. Compare our workmanship and price with your own figures. We feel sure you'll become another customer for our "Tailor-Made" products



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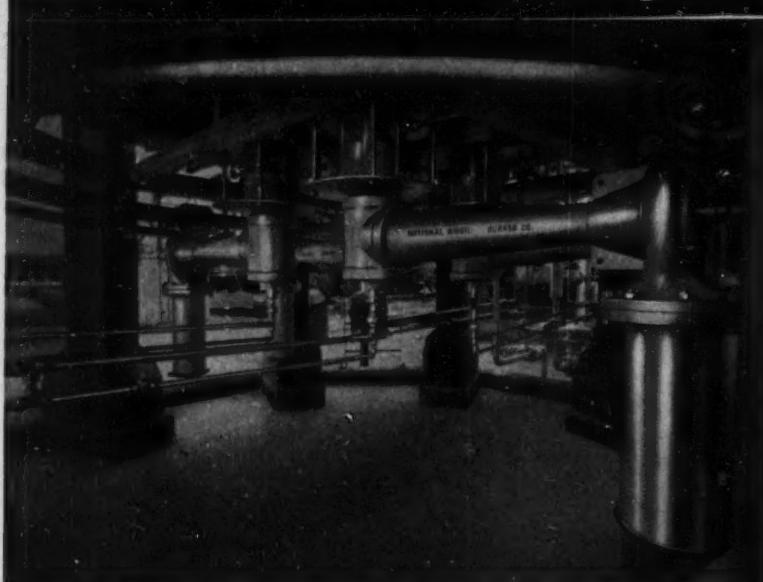
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*here's a familiar sight!*



**petroleum heaters vertically fired with...**

### National Airoil Oil-Gas Tandem Combustion Units

Here's Why . . . because NATIONAL AIROIL Tandem Block Units are more than just "burners." They are an exclusive up firing system which has proved many more hours *on stream* without shutdown. AIROCOOL Tandem Units (firing dirty refinery gas, asphalt, refinery fuel oils) hold air in the Combustion Zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: *high fuel economy* through more rapid combustion with a minimum of excess air.

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The tandem unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame . . . maintains required flame temperature using either fuel oil or gas. With the tandem unit's clean flame, a cold furnace can be brought to full capacity in a short time.

You will realize higher profits from YOUR heaters when NATIONAL AIROIL Tandem Combustion Units are specified.

STEAM ATOMIZING OIL BURNERS  
OIL BURNERS and GAS BURNERS  
for industrial power, process and  
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MOTOR-DRIVEN ROTARY OIL  
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**INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT**

# THERE'S A MONARCH NOZZLE FOR EVERY SPRAY JOB

Remember—if the liquid can be sprayed with direct pressure Monarch can furnish the Nozzles



Fig. F80

In many industries  
Monarch Spray  
Nozzles are used for:  
**ACID CHAMBERS**  
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**COOLING PONDS**  
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Catalogs 6 A and 6 C  
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# **Accidental Thermal Shock?**

**... THERE'S NOTHING  
FRAGILE ABOUT**

# **Lapp TUFCLAD.**

**SOLID Chemical Porcelain ARMORED with Fiberglass-**

## **Reinforced Plastic**

**Now** you can gain the advantage of solid chemical porcelain purity and chemical resistance in a system which offers extra protection to personnel, equipment and product. Lapp TUFCLAD armor—multiple layers of Fiberglass fabric impregnated and bonded to the porcelain body with an Epoxide resin of high strength and chemical resistance—cushions accidental blows, insulates against thermal shock. Besides, it is itself tough and strong—will hold operating pressures against gross leakage, even if porcelain is cracked or broken. **WRITE** for description and specifications on Lapp TUFCLAD porcelain valves, plug cocks, safety valves, flush valves, pipe, fittings and special shapes.

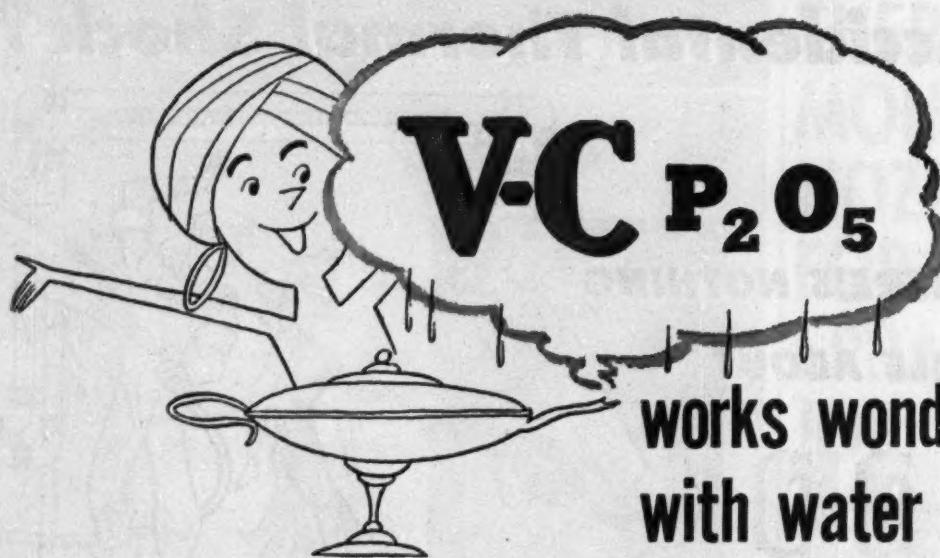
**Lapp Insulator Co., Inc., Process Equipment  
Division, 702 Maple St., Le Roy, N. Y.**



**Lapp**

**PROCESS EQUIPMENT**

CHEMICAL PORCELAIN VALVES • PIPE • RASCHIG RINGS  
PULSAFEEDER • CHEMICAL PROPORTIONING PUMPS



## works wonders with water

Whether you are manufacturing cleansers or water softeners, processing textiles or cheese, dispersing clay or treating boiler water, it will pay you to investigate the advantages of V-C Sodium Phosphates. Their water-softening ability, emulsification and dispersion properties and free-rinsing quality over a wide range of uses are outstanding. Examine the individual characteristics of each V-C Sodium Phosphate, outlined below, then write for full details.

### V-C DSP

(Disodium Phosphate)  
Anhydrous

**Specifications:** Minimum  $P_2O_5$  content is 48.0%; less than 2% moisture. The pH of a 1% DSP solution is 9.0.

**Physical Properties:** Small white flakes, readily soluble giving a clear solution.

**Characteristics:** Mild alkalinity, emulsifies fats and oils, "deflocculates" or suspends solids, is a good buffer.

**Advantages:** Anhydrous DSP contains no water of crystallization as does the duohydrate DSP or crystalline (12 H<sub>2</sub>O) DSP. Very economical, less alkaline than TSP, excellent water softener.

**Uses:** Boiler water treatment to control caustic embrittlement, textile cleaning, manual cleaners, plasticizer in the manufacture of processed cheese, and many other uses.

### V-C TSP

(Trisodium Phosphate)

**Specifications:** Surpasses requirements of Federal Specification O-T-671e and ASTM Specification D538-44.  $P_2O_5$  content is 18.5%. The pH of a 1% TSP solution is 11.8.

**Physical Properties:** Easily soluble white crystals.

**Characteristics:** Readily emulsifies fats and oils, softens water, "deflocculates" or suspends solids, rinses clear.

**Advantages:** Has higher alkalinity than DSP or polyphosphates. Good water softener. Economical.

**Uses:** For manufacture of cleansers, cleaning compounds, soaps and water softeners. Also for metal cleaning, boiler water treatment, textile processing, and other uses.

### V-C STPP

(Sodium Tripolyphosphate)  
Anhydrous

**Specifications:** Minimum  $P_2O_5$  content is 57%; less than 1% moisture; calcium value, 10. The pH of a 1% STPP solution is 9.8.

**Physical Properties:** Anhydrous white powder (finer than 20-mesh), soluble in water.

**Characteristics:** Mild alkalinity, good sequestering agent, very effective peptizing agent, fairly stable.

**Advantages:** Greater sequestering power than TSPP. Cheaper than organic sequestrants. More stable than other polyphosphates except TSPP.

**Uses:** Builder for synthetic detergents and soaps, boiler feedwater treatment, industrial cleaners, textile processing, paper manufacturing, clay dispersing and many other uses.

### V-C TSPP

(Tetrasodium Pyrophosphate)  
Anhydrous

**Specifications:** Minimum  $P_2O_5$  content is 53%; less than 1% moisture; 90.0% Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>. The pH of a 1% solution is 10.2.

**Physical Properties:** Anhydrous white powder (finer than 20-mesh), soluble in water.

**Characteristics:** Exceptional water softening ability, high emulsification and dispersion properties, mild alkalinity, good buffering and rinsing properties, very stable.

**Advantages:** More stable than other polyphosphates. More economical than organic sequestrants and other polyphosphates.

**Uses:** Builder for synthetic detergents and soaps, mud treatment, water treatment, textile processing, industrial cleaners, cheese manufacture, cold water paints and other uses.

Elemental Phosphorus

Phosphoric Acids

Trisodium Phosphate

Disodium Phosphate-Anhydrous

Tetrasodium Pyrophosphate

Sodium Tripolyphosphate

Ferrophosphorus

Sodium Mersalicate

Tetraethyl Pyrophosphate

Alkyl Phosphites

Other Organic Compounds

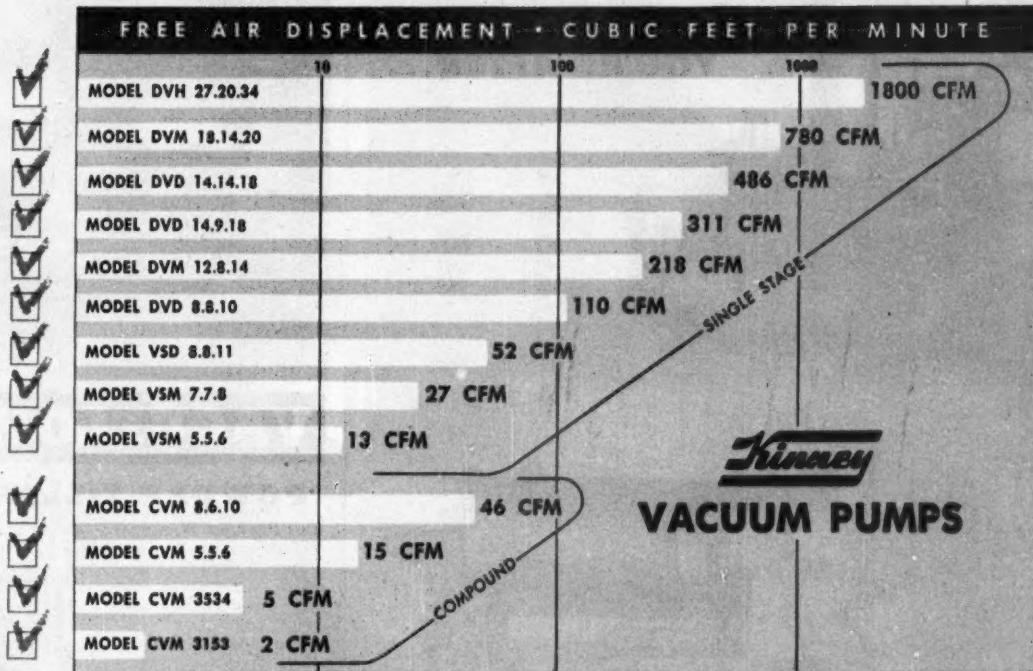
of Phosphorus



VIRGINIA-CAROLINA CHEMICAL CORPORATION • Chemicals Division: 401 East Main Street, Richmond 8, Virginia



# More pumps to pick from!



**What's your vacuum problem?** Kinney offers you the BIG LINE of vacuum pumps — the broadest range of mechanical, oil-sealed vacuum pumps on the market. Pick the exact pump you need from our line. Get fast pump-down, fast recovery speed, and reliable low absolute pressure — and get them efficiently and economically by buying the Kinney Pump that's right for the job. Experienced vacuum engineers, here in Boston and in all our branch offices, will be glad to discuss the applications of vacuum in your plant.



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2351 WASHINGTON STREET • BOSTON 30, MASS.

<input type="checkbox"/>	Please send Bulletin V-51B describing the complete line of Kinney Vacuum Pumps. Our vacuum problem involves:	Name _____
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<input type="checkbox"/>	Vacuum coating	Address _____
<input type="checkbox"/>	Vacuum metallurgy	City _____
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Kinney Manufacturing Co., Boston 30, Mass. Representatives in New York, Chicago, Detroit, Cleveland, Atlanta, Philadelphia, Pittsburgh, Johnstown (Pa.), Los Angeles, Charleston (W. Va.), Houston, New Orleans, San Francisco, Seattle, and foreign countries.

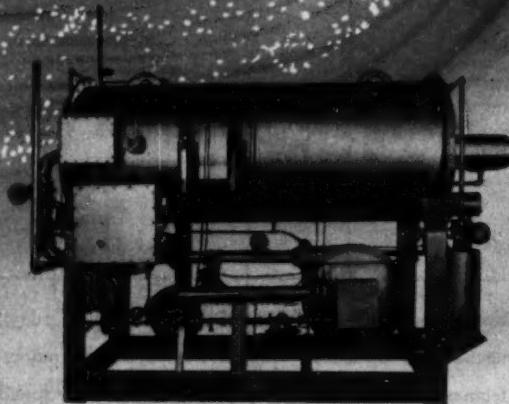
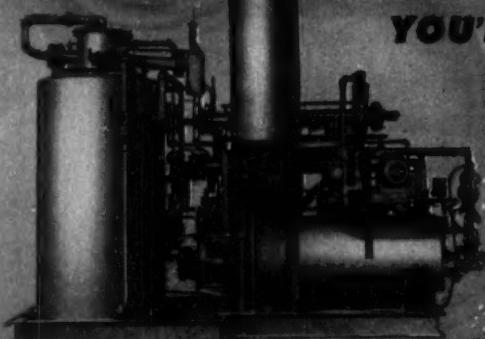


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For more complete information write for Bulletin number I-552

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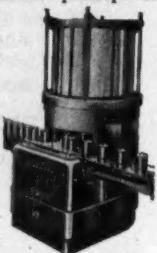


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Semi-automatic models are available for filling containers ranging from the tiny talcum box up to and including 100 lb. paper bags and 200 lb. drums. Rotary models are available for automatic production of 5 lb. sizes or less at speed of 45 to 300 per minute.



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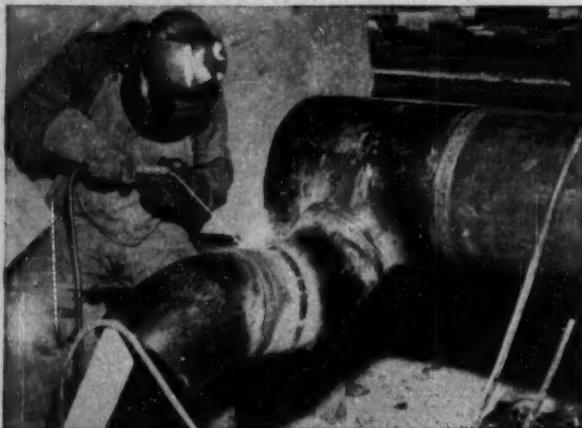
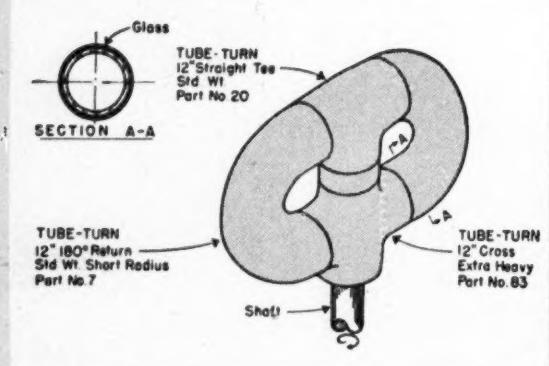


ENGINEERING SERVICE

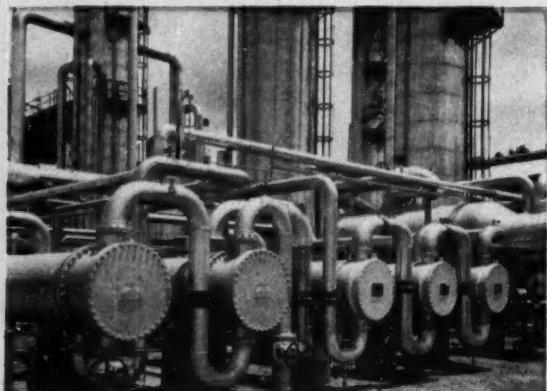
# TUBE TURNS' Engineering Service HELPS SOLVE A VIBRATION PROBLEM

**T**UBULAR CONSTRUCTION often solves tough machine design problems and here, as in piping problems, Tube Turns' Engineering Service is ready to help you! For example:

Vibration was cracking the glass coating of a plate type agitator for a brine tank in a chemical plant. After repeated replacements, the engineers decided to switch to tubular construction and called in Tube Turns' Engineering Service for design assistance. The resultant design, shown in the sketch, embodies great rigidity and is not affected by the vibration. The expensive maintenance caused by cracking of the agitator's glass coating was eliminated.



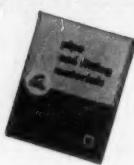
**FABRICATION IS FAST.** Field or shop fabrication of piping assemblies is easier when welders can count on the dimensional accuracy of TUBE-TURN Welding Fittings. True circularity and uniform wall thickness assure perfect lineup and fit.



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Tube Turns, Inc. has announced a blanket Union preserves true roundness of pipe and fitting materials - carbon steel, low pressure brass, stainless steel, nickel and nickel alloys, copper, aluminum, lead, zinc, glass, ceramic.

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224 East Broadway • Louisville 1, Kentucky



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Position .....  
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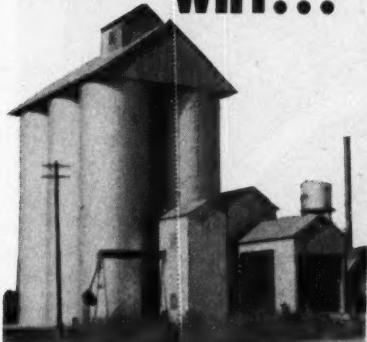
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**3 ADAPTABLE**—Many sizes are available, unlimited arrangements are possible. Choose Air-Cell or solid concrete staves. Roof and wall can support materials handling equipment. Tanks can be erected on platforms, with connecting tunnels, or inside existing structures.

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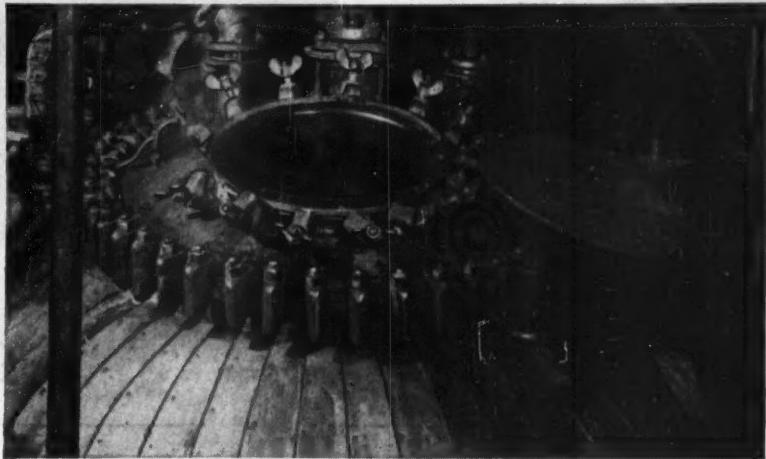
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## SARAN RUBBER LINED KETTLE RESISTS HOT HYDROCHLORIC ACID

Another example of how SARAN RUBBER TANK LINING helps cut cost of handling, storing or transporting corrosives



Here's a typical saran rubber tank lining application. This 2,000 gallon kettle, with baffle and agitator, handles hydrochloric acid and crystal slurry at 50° C. Lined with saran rubber over a year and a half ago, the kettle has given efficient and constant service since.

Saran rubber's high degree of chemical and abrasive resistance makes it the ideal lining for tank cars, storage tanks, tank trailers, processing tanks and other equipment handling corrosive acids, solvents, and other chemicals.

Saran rubber lining can be applied easily and economically by experienced saran rubber applicators located strategically throughout the country. We will be glad to advise you as to where and how saran rubber lining can be applied to your best advantage. Get in touch with your nearest SARAN LINED PIPE COMPANY office or write direct to The Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan. Offices in New York Boston • Pittsburgh • Tulsa • Philadelphia • Chicago • Portland • Indianapolis San Francisco • Houston • Denver • Los

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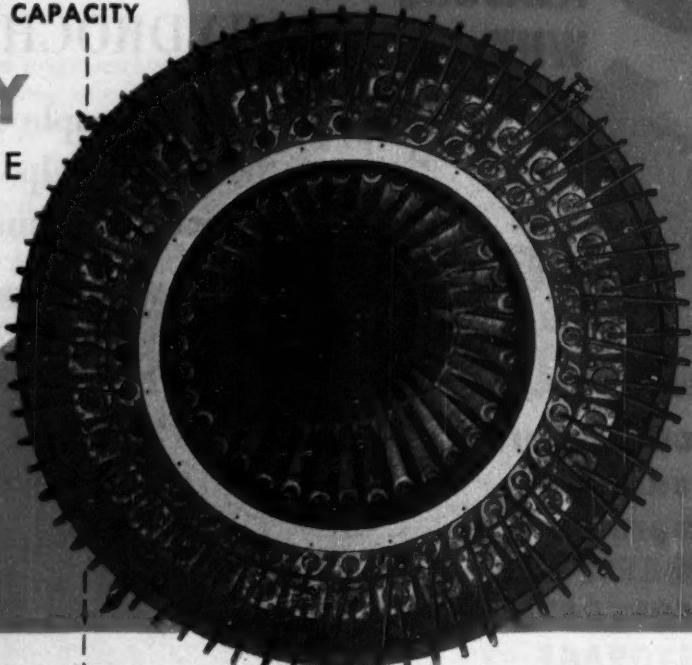


*the heart*

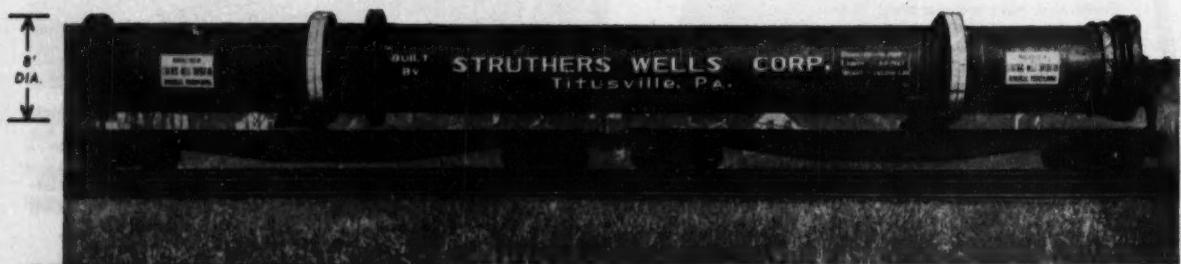
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FOR A LEADING  
CHEMICAL PRODUCER



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Designers and Builders  
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Processing Equipment

The striking illustration above is an end view of a recently completed rotary steam tube dryer with the housing removed to show the piping manifold connecting ends of the finned tubes. Note that the three layers of steam tubes are carefully supported and provide for expansion—a most efficient construction for this type of heavy duty dryer.

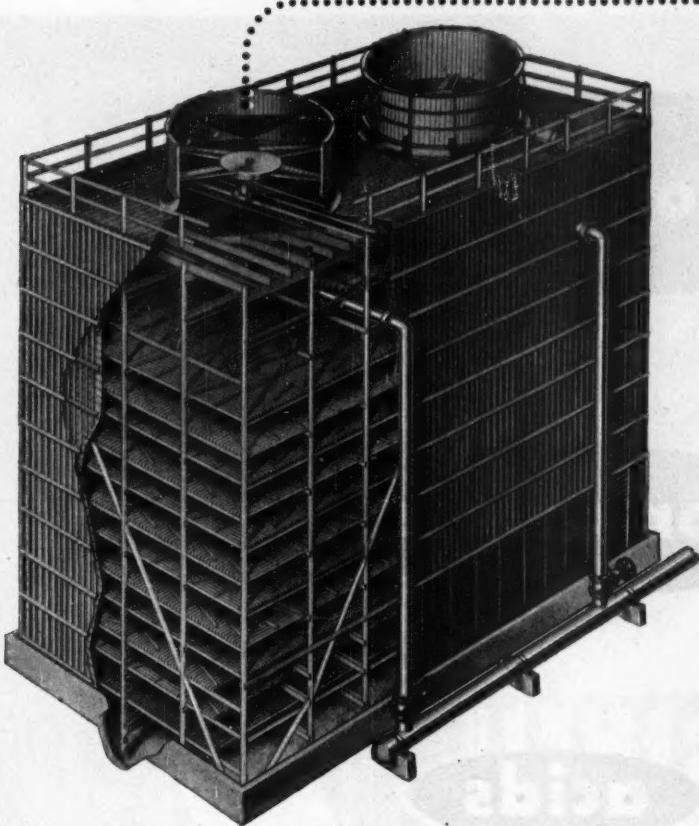
Two railroad cars were required to transport this 8' dia. x 98' long unit—supported on two large tires and double trunnion roller bases. A third car was used to ship the end housings, trunnion bases and gear drive.

This large steam tube dryer is an excellent example of Struthers Wells experience and facilities to produce specialized equipment to meet your specific production requirements.

**STRUTHERS WELLS CORPORATION**

PROCESS EQUIPMENT DIVISION • TITUSVILLE, PA.

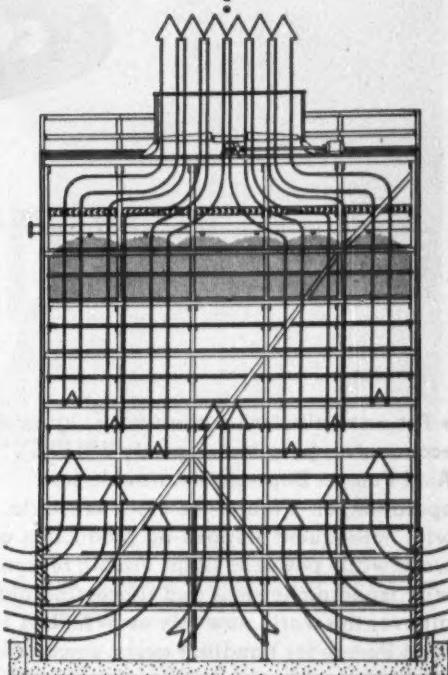
Plants at Titusville and Warren, Pa. • Offices in Principal Cities



Heavy stainless steel fan blades are finely balanced, resist corrosion and are mounted on shafts whose exceptionally high fatigue strength has been substantiated by strain gauge tests and actual use. Pitch is adjustable to efficiently handle required air volumes at minimum tip speeds and horsepower requirements — more air per kilowatt. Speed reducers incorporating spiral bevel gears feature oil-bath lubrication and dry-air breather. The low-speed fan shaft is mounted on special steep angle thrust with radial bearings to take the combined gear thrust, fan thrust and weight of fan assembly. Driving mechanisms are built for hard-wearing, maintenance-free performance and for smooth, quiet operation.

Vibration Cut-out switches, exclusive with Fluor Cooling Towers, are an emergency safety device that stops the motor should excessive vibration accidentally occur, preventing possible damage to the tower or mechanical equipment. Design employing internal gusset plates duplicates that used in wooden bridge construction. These connectors add greater tensile and compressive strength to structural members, lower the total weight of towers, require less erection time and materially increase tower life. Sloping grid decks of rough-finished redwood with minimum one-inch dimension are used as scaffolding during erection and provide maximum deck surface with negligible air pressure drop through the tower.

## *Efficiency of FLUOR COUNTERFLO Cooling Towers begins at the top*



Air distribution is controlled at every stage of its travel through the tower. Louver height is designed to obtain the desired intake velocity and wind-deflectors inside the tower uniformly direct air currents to all areas. Approach to the desired wet-bulb temperature is easily accomplished and performance to customer's specifications is guaranteed in every case.

Only Fluor Counterflo Cooling Towers are completely prefabricated. All cutting, drilling, and nailing is performed at the factory and tower parts are "packaged" for rapid delivery, marked for orderly assembly. More efficient control of the quality of straight-grained heart of California redwood and excellent workmanship in Fluor towers are maintained through prefabrication. Inexperienced craftsmen and laborers under Fluor's supervision can erect a Fluor tower in a minimum of time and at considerable savings in erection costs. Prefabrication means standardization; parts that may become worn or damaged over the years may be replaced economically. Uniformity of appearance as well as performance is assured.

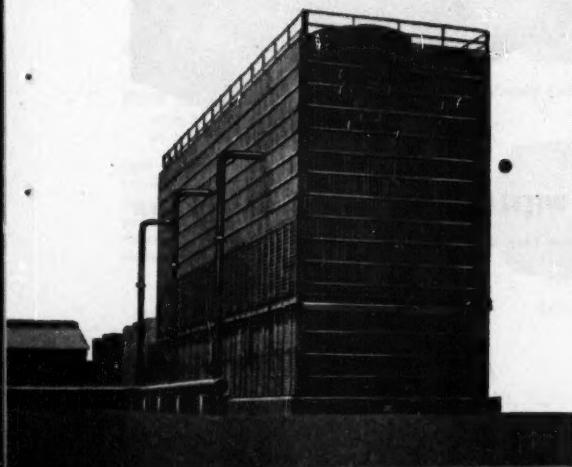
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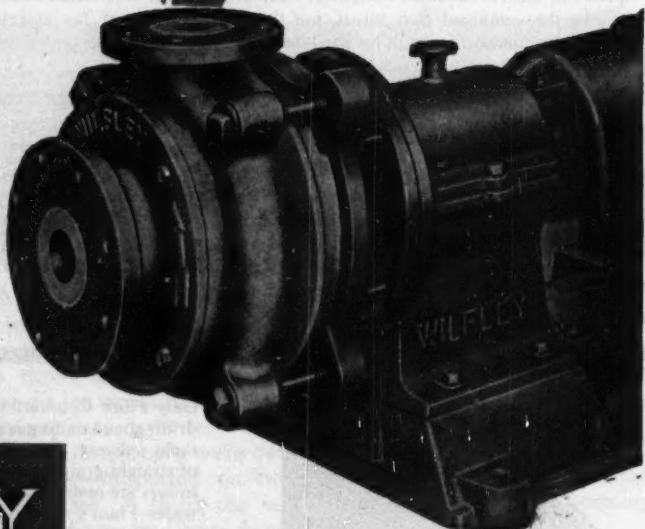
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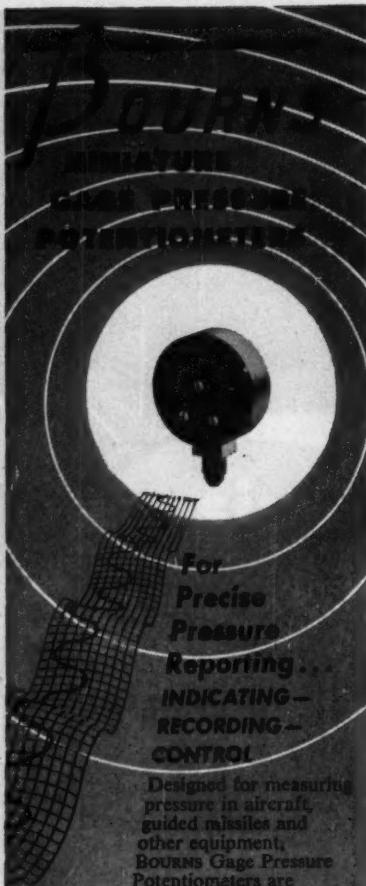
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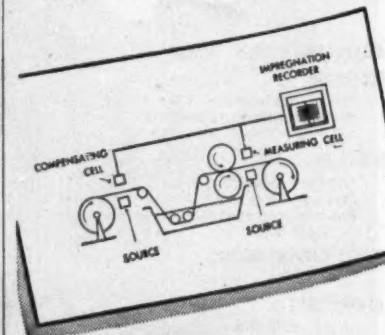
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Technical Bulletin on request, Dept. 143

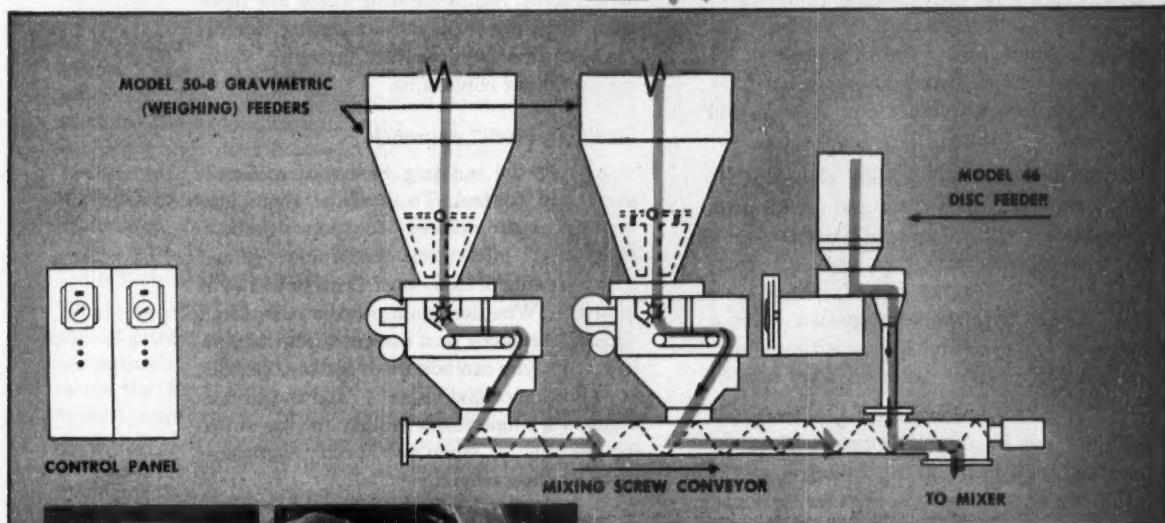
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Here's another of the many Omega Continuous Feeding and Proportioning "Packages" now working in processing industries. It's automatic — feeds three dry materials simultaneously in correct proportions directly into a screw conveyor. Guaranteed accuracy of the Gravimetric Feeders is within plus or minus 1% by weight over a 100 to 1 feed range.

Omega Equipment "Packages" are designed to individual processing requirements and specific plant layouts. Our engineers are ready to work with you to suggest the most efficient feeding and proportioning system for your needs.



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- Send Application Memo 35-J1 describing 3-Ingredient Feeding and Blending System.
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Co., Industrial Division, 4478 Wayne Ave.,  
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• **REFERENCE DATA:** Write for Composite Catalog No. 5000 for a condensed description of the complete Brown line.



GAS FLOW to Surf spray tower heaters is recorded by Brown Flow Meter . . . one of many in this plant. At top are Honeywell diaphragm control valves.

**Honeywell**  
MINNEAPOLIS  
BROWN INSTRUMENTS

*First in Controls*

# **FLASH! ..Here's a SCOOP AND IT'S FULLY AUTOMATIC**



The Jeffrey Power Scoop is shown above—cable reel direct-driven from motor and reducer, all mounted on substantial base. Drawing shows material being moved to the car door for discharging into hopper—or chutes, elevators or conveyors.

Positive control and safe operation are features of this NEW Jeffrey Automatic Power Scoop. Used for unloading bulk material from box cars, this SCOOP is fully automatic, light in weight, and can be moved backward and forward at will before moving the material to the door for discharging. *An electric push button in the handle makes operation easy.* When pulling Scoop back, cable is unreeled only to required length—no slack to interfere. One man can do the work. Write for additional information.



**THE JEFFREY** ESTABLISHED 1877  
**MANUFACTURING CO.**

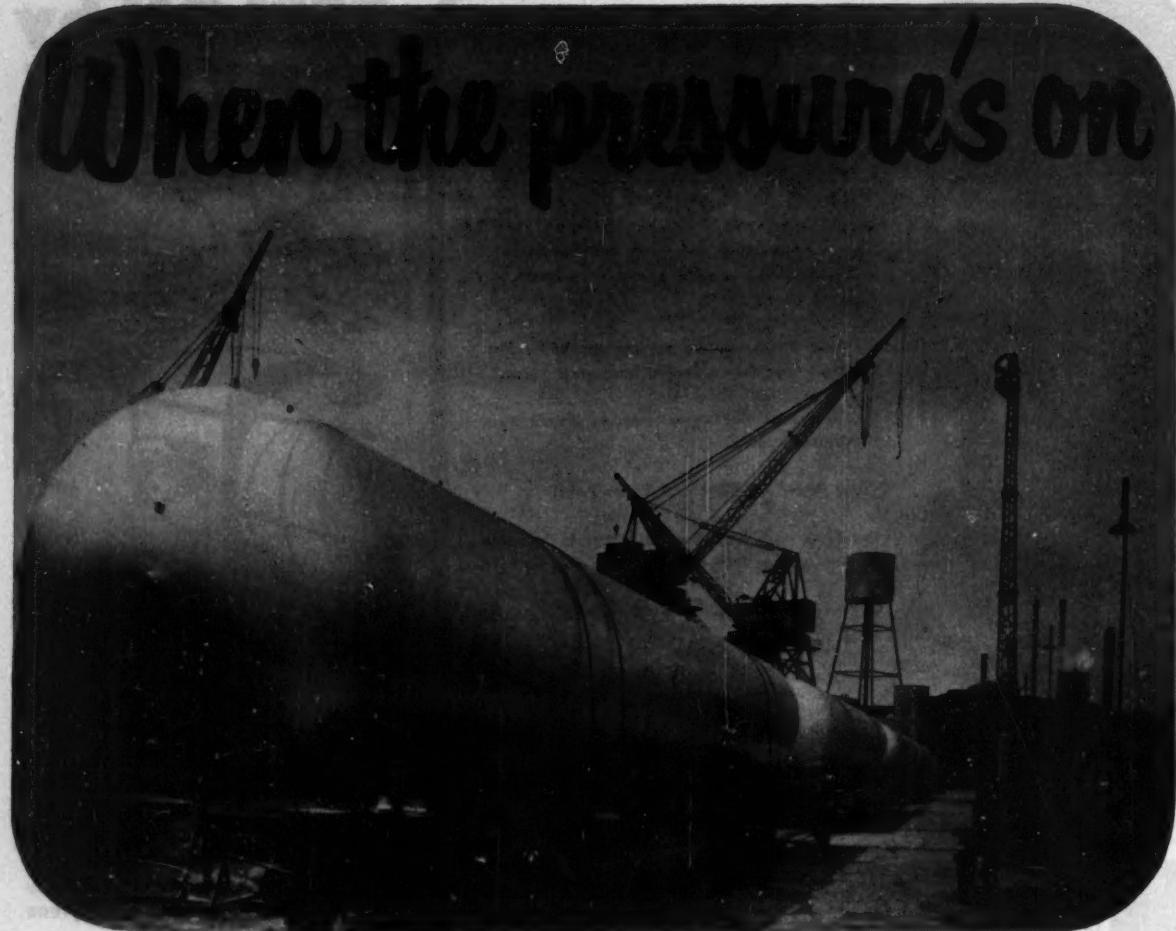
Columbus 16, Ohio

*sales offices and distributors  
in principal cities*

**PLANTS IN CANADA, ENGLAND, SOUTH AFRICA**

**IF IT'S MINED, PROCESSED OR MOVED  
...IT'S A JOB FOR JEFFREY!**





Another trainload of huge Pressure  
Vessels leaves Sun Ship's Chester plant.

If you're ever in the market for large high-pressure tanks—that's a good time to think of Sun Ship.

Construction of these giant tanks . . . whether for operating or for storage under pressure . . . whether for land or marine installation . . . has been an important part of Sun Ship's work for the petroleum and chemical industries for many years.

The trainload shown above, which includes tanks of 55,000-gallon and 30,000-gallon capacities—used for storing L.P.G.—typifies Sun Ship's experience in building large tanks which must carry pressure.

Shipments of these and of other huge vessels in carloads or trainloads is a familiar sight at the busy Chester plant. Fractionating towers, stills, catalytic cracking cases, reactors and other specialized equipment are turned out at Sun Ship's great and versatile plant on the Delaware, from which shipment can be made either by rail or by water.

**Sun**  
**SHIPBUILDING & DRY DOCK COMPANY**  
SINCE 1916

ON THE DELAWARE • CHESTER, PA.  
25 BROADWAY • NEW YORK CITY



**2 PM RUSH ORDER!**

**9 AM DELIVERY!**

**WITH KAISER ALUMINA**

A manufacturer was faced with a costly plant shutdown not long ago because of a low inventory of alumina. One phone call to Kaiser Chemicals at 2 P.M. solved his problem—at 9 A.M. the following morning the required alumina was at his plant siding.

While this 19-hour service is not always required, it illustrates that, with Kaiser Chemicals, orders get *immediate, individual* attention, cutting delivery time, making large, costly inventories unnecessary.

This personal service—combined with unsurpassed quality and experienced technical assistance—has made Kaiser Chemicals a major supplier of calcined and hydrated aluminas. Operating one of the largest alumina plants in the country, we supply alumina to more than eighty per cent of the nation's users.

Whether you manufacture abrasives, glass, ceramics, re-

fractories, catalysts, or chemicals for water treatment, we have the product and the service to meet your needs exactly. Contact principal sales offices: *Chemical Division, Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, California; First National Tower, Akron 8, Ohio.*

# Kaiser Chemicals

**calcined and hydrated aluminas**

Alumina • Basic Refractory Bricks and Ramming Materials • Dolomite  
Magnesia • Magnesite • Periclase

# MIDWEST

*The Only Change is in the Name*

MIDWEST PIPING & SUPPLY CO., INC.

has Changed its Name to

# Midwest Piping Company, Inc.

6283

Because the word "Supply" is no longer accurately descriptive of the major business operations of this company, the stockholders have voted to drop it from the corporate name.

There has been no change in management, ownership or business at Midwest . . . and none is contemplated. Only the name has been changed. Midwest continues all its activities in the fabrication and installation of piping, and in the manufacture of welding fittings.

## MIDWEST PIPING COMPANY, INC.

*Executive Offices: 1450 South Second St., St. Louis 4, Mo.*

*Plants: ST. LOUIS, PASSAIC, LOS ANGELES and BOSTON*

*Sales Offices: NEW YORK 7-58 CHURCH ST. • TULSA 3-224 WRIGHT BLDG.  
CHICAGO 3-79 WEST MONROE ST. • LOS ANGELES 33-520 ANDERSON ST.  
HOUSTON 2-1213 CAPITOL AVE. • BOSTON 27-426 FIRST ST.*

PIPING FABRICATORS AND CONTRACTORS FOR MORE THAN 50 YEARS  
MANUFACTURERS OF WELDING FITTINGS FOR MORE THAN 20 YEARS

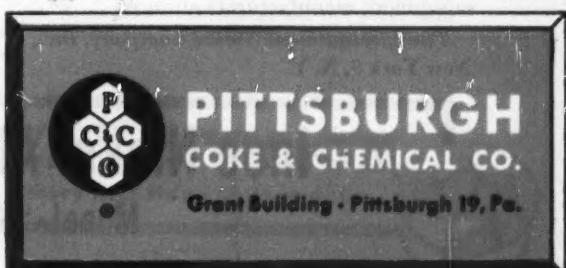
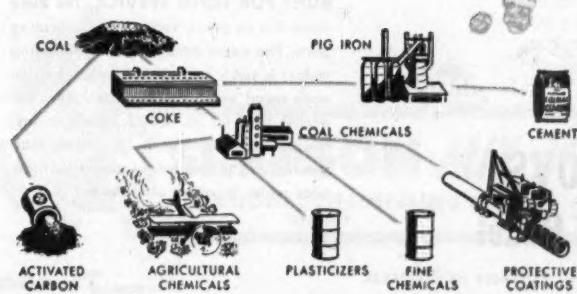


# Point of Integration— for a Bridge and a Bug Killer

A few hours ago, this incandescent cascade of coke was 18 tons of bituminous coal. Until we put the heat on it in one of Pittsburgh's 140 coke ovens, it held a tight grip (dating back to the dinosaurs!) on chemicals for a new Pittsburgh insecticide and the basic ingredients for building a steel and concrete bridge . . . to name just a few of Pittsburgh's coal-derived products.

Highly diversified production? Sure, but completely integrated too. For the steady growth of Pittsburgh Coke & Chemical Company has always followed the natural flow of integrated production.

Today, in our 25th Anniversary Year, the operation of each of Pittsburgh's ten divisions is meshed in one highly coordinated production pattern. The company's customers, perhaps more than anyone else, know the ultimate benefits of this unique production position: Assured product quality and dependable, continuing supplies . . . because Pittsburgh is *basic*.



# If you're pumping corrosives

**...Monel (or "K" Monel)  
may be the answer  
to your shafting problem**

If you're pumping corrosive chemicals, salt water or gas-bearing brines, chances are you've had pump shaft trouble more than once.

Next time a replacement is necessary, consider using a shaft of Monel® or "K"® Monel.

Like all Inco Nickel Alloys, Monel is highly resistant to corrosion, erosion and wear.

Monel's companion alloy, "K" Monel, has all these characteristics, too, plus extra strength and hardness equal to that of many heat-treated alloy steels.

Both Monel and "K" Monel are employed for parts that must withstand heavy vibration, constant stress and sudden torque in the presence of corrosives.

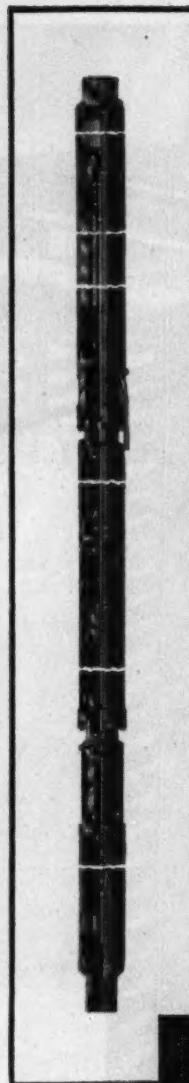
As an example of what either one of these alloys can do in meeting a serious problem, take this experience of a Michigan processor pumping a chemical brine . . .

At 2,400 feet, the pumping rate was 90 gallons a minute. Corrosion of the pump shaft continually hampered production. There was no further trouble, however, after the pump was re-equipped with a "K" Monel shaft!

Other operating troubles, too, are often eliminated when Inco Nickel Alloys like Monel and "K" Monel go to work. These high-strength metals have proved their value for use under corrosive conditions. Keep them in mind — there's a good possibility they can solve one of your equipment problems. And ask Inco's Corrosion Engineering Service for help whenever you need it. You won't be obligated in any way.

Remember, though, that Inco Nickel Alloys are much-wanted metals. It pays to anticipate your needs as far in advance as you can, and then to place your orders with equipment manufacturers at once.

*The International Nickel Company, Inc., 67 Wall St.,  
New York 5, N. Y.*



**BUILT FOR LONG SERVICE.** The Reda pump has no gears, valves or reciprocating parts. The entire producing unit (including motor) is small enough to be run easily in wells cased with small diameter pipe. Capacity: from 20 to 13,000 barrels a day; lifts up to 13,000 feet. A "K" Monel shaft assures long life and dependable performance under corrosive conditions.



## Inco Nickel Alloys Monel • "K" Monel

*...Your Partners in Progress*

## IN YOUR PLASTICS PREPARATION...



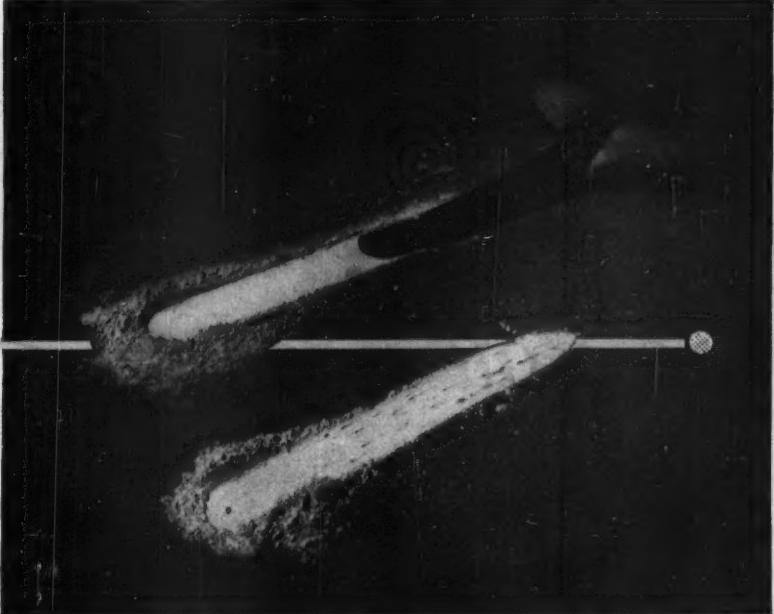
is QUALITY  
ABOVE OR  
BELOW "PAR"?



### DO YOU KNOW WHAT MULLING IS?

Watch the practiced technique of a chemist's mortar and pestle—the intensive rubbing and smearing actions—and basically, THAT'S MULLING!

Mulling with SIMPSON Mix-Muller utilizes a special pair of revolving mullers and plows mounted on a stationary pan. The mullers are adjustable and are supported by rocker arms. This leaves them free to ride on the material, creating a true mulling action as they revolve. The results are thorough, more rapid blending.



### ...rely on SIMPSON MIX-MULLERS FOR ACCURATE CONTROLLED BLENDING

Whether you are a basic producer of raw materials or are producing plastic products . . . the quality and the uniformity of your finished product is greatly dependent upon the care given to the mixing of components.

A simple "smear test," as pictured above, can provide visual proof of quality. Unmixed smears or hard lumps, as shown in the lower smear, mean rejects and waste . . . defective moldings or extrusions . . . or improper color dispersion.

Equipment which is designed to perform the tough job of masticating or kneading viscous plastic material cannot be depended upon to produce the fine dispersal of pigment or plasticizer which could be produced from material shown in the upper smear . . . material which has been *mulled* in a Simpson MIX-MULLER.

Built in 12 sizes from 1/10 to 60 cu. ft. batch capacities, the Simpson MIX-MULLER is widely used for premix and full production in the preparation of plastics and plastic products. They may be equipped for heating with oil, water or steam or for full cool or warm air circulation . . . to meet every mixing requirement.

If you're shooting "under par" on quality . . . investigate controlled mulling with Simpson MIX-MULLERS.

**USE OUR FREE LABORATORY SERVICE** . . . We have a completely equipped testing laboratory for accurately determining the results of mulling your materials in Simpson Mix-Mullers. A confidential laboratory test will prove what a Simpson can do for you. Write for details—no obligation, of course.



**SIMPSON MIX-MULLER® DIVISION**  
NATIONAL ENGINEERING CO., 604 Machinery Hall Bldg., Chicago 6, Ill.  
(Not Inc.)

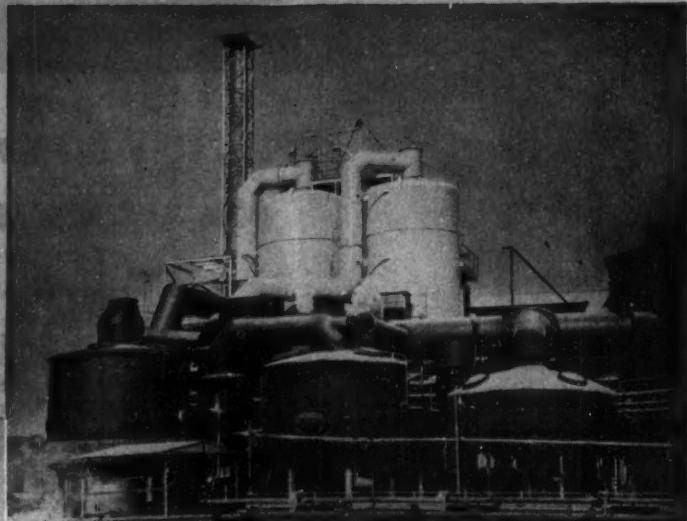


# *How much sulfuric acid do you need?*

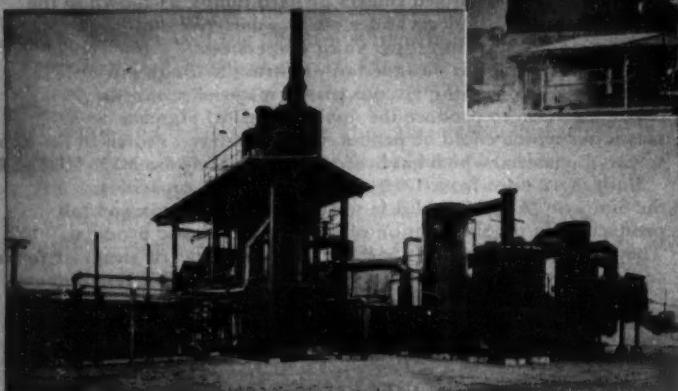


Among the many Chemico-built contact sulfuric acid plants in service today all over the world, one has a capacity of only five tons per day. Another produces more than five hundred tons per day. Others range in between.

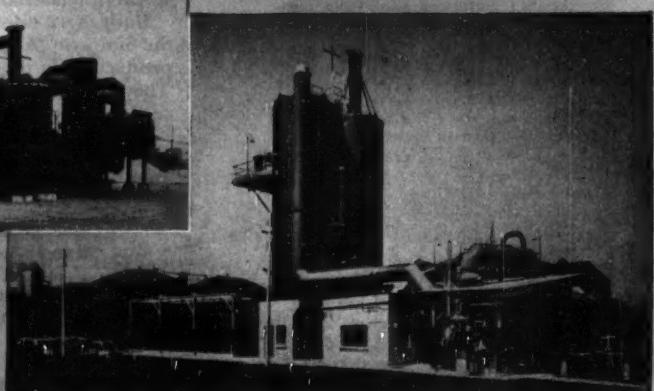
Whatever your sulfuric acid requirements are, Chemico will design and furnish you with a highly efficient plant exactly suited to your needs...on a one-contract, guaranteed-performance basis.



*500 Tons*



*50 Tons*



*200 Tons*

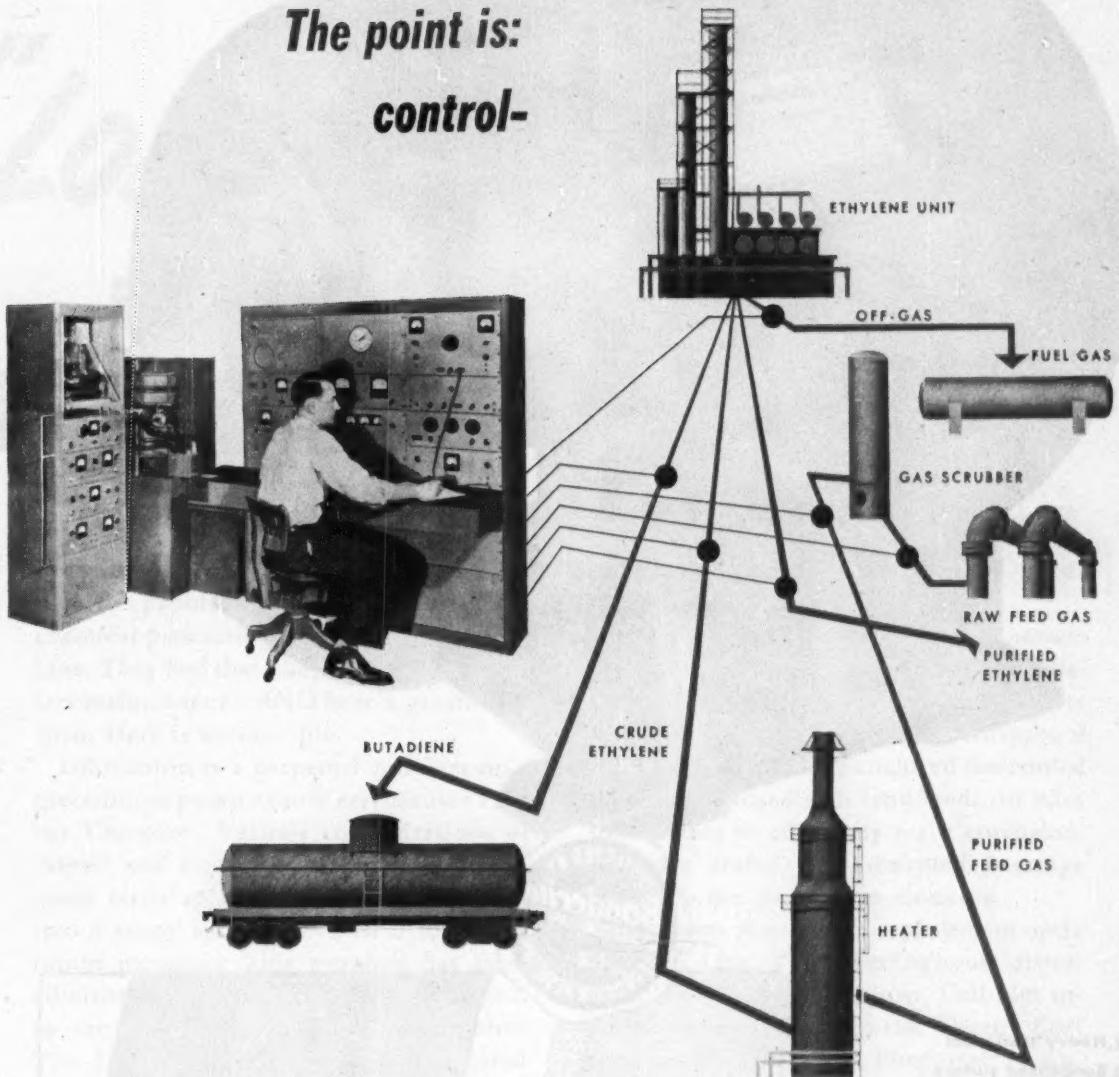
**CHEMICAL CONSTRUCTION CORPORATION**  
A UNIT OF AMERICAN CYANAMID COMPANY  
488 MADISON AVENUE, NEW YORK 22, N. Y.

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TECHNICAL REPRESENTATIVES: CYANAMID PRODUCTS LTD., LONDON • CHEMICAL CONSTRUCTION  
(INTER-AMERICAN) LTD., TORONTO • SOUTH AFRICAN CYANAMID (PTY) LTD., JOHANNESBURG



*Chemico plants are  
profitable investments*

**The point is:  
control-**



IN THE huge Texas plant of Jefferson Chemical Company, Inc., at Port Neches, Texas, approximately 50,000 complex control analyses of hydrocarbon mixtures have been made on a single Consolidated Analytical Mass Spectrometer since 1947. These figures indicate the speed, accuracy, and trouble-free service that can be built into a sensitive analytical instrument. For year-in, year-

out operation this versatile control instrument offers decided advantages: the cost-per-analysis is only a fraction of the cost by any other method and the results are available in permanent graphic form in a fraction of time otherwise required. One operator and a Consolidated Mass Spectrometer will accomplish complete control over the most complicated chemical processes—in minutes.

## Consolidated Engineering

CORPORATION

300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.**,  
a subsidiary with offices in: Pasadena, Philadelphia,  
New York, Chicago, Dallas

analytical  
instruments  
for science  
and industry

## Mass Spectrometer

The Consolidated Analytical Mass Spectrometer shown above is used extensively by leading refineries throughout the world for analytical research as well as process control. For complete information on this instrument, write for Bulletin CEC 1800-X3



**Bonderizing and 4 protective coatings  
ADD SERVICE LIFE**

All exposed parts of the Life-Line chemical motor are Bonderized. We know of no other motor manufacturer who assures longer life in chemical service with this extra protection. After Bonderizing, a special formaldehyde-alkyd type enamel is applied; then two coats of Thermoset varnish; finally a coat of dark-gray lacquer. On-the-job performance proves this is the best type of motor for chemical service.

# "Longer Life... in chemical service" say these Life-Line users

More and more plant operators confronted with the problem of operating motors for chemical processing are switching to Life-Line. They find that Life-Lines operate with less maintenance—AND have a greater life span. Here is an example:

Lubrication is a perpetual problem on a green liquor pump at the Weyerhaeuser Timber Company. Various concentrations of caustic and lime dust, together with frequent water splashing turn grease and oil into a soapy substance—useless for lubrication purposes. This problem has been eliminated, as far as the motor is concerned, by the installation of a Life-Line motor. The Life-Line has sealed, pre-lubricated

bearings—keeps foreign matter out—needs no lubrication.

Proof of performance like this means your best buy for chemical motors is Life-Line. They are available in a complete range of enclosures . . . open—driproof—splashproof—totally-enclosed fan-cooled—totally-enclosed non-ventilated. All have steel frames to effectively resist corrosion. All have sealed, pre-lubricated bearings that keep out destructive elements.

Cut down your motor replacement cycle with Life-Line. Your Westinghouse representative will show you how. Call him today or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21634-A

YOU CAN BE SURE...IF IT'S  
**Westinghouse**





## everything in stainless... including the kitchen sink

Whether you require stainless steel in bars — round, square, flat or hexagonal... billets... sheets... plates... wire... or angles, there is a form of Crucible REZISTAL stainless that will fill your specific needs. And Crucible REZISTAL stainless steel is available in a wide assortment of grades, gauges and finishes to meet the diversified requirements of all industries.

Crucible's staff of metallurgists and stainless fabricating specialists are well experienced in solving application problems in the chemical, food processing, dairy, textile, laundry, hospital, pulp and paper and a host of other fields — including uses for Crucible REZISTAL in household articles like cutlery, cooking utensils and the proverbial *kitchen sink*.

If you have a specialized application where the unique qualities of stainless will improve your product or your processing operations, don't hesitate to call in a Crucible representative who can give you the benefit of our broad experience. And when you buy stainless, be sure you specify Crucible REZISTAL, the quality brand of heat and corrosion resistant steels.

**CRUCIBLE**

first name in special purpose steels

53 years of *Fine* steelmaking

**STAINLESS STEEL**

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

# BUY POLYOLS ON FACTS



Sorbitol has a pleasant taste . . . no color or odor

Sorbitol is uniformly free of undesirable tastes, colors and odors. This characteristic is especially important if you're using a polyol in elixirs, mouthwashes, toothpaste, candy, cosmetic creams or lotions. Sorbitol's natural sweet cool taste makes a valuable *plus* feature in addition to its inherently superior properties as a moisture-conditioner and bodying agent. And there's no color or odor to affect your blend of other ingredients . . . nothing about sorbitol that needs to be removed or masked.

## ...and sorbitol costs less today than ever

Sorbitol has dropped steadily in price . . . in war, peace and during times of inflation. This has been due to sorbitol's low-cost, practically unlimited raw material (mostly corn sugar) . . . and to continued expansion and refinement of the Atlas process.

## COMPARE ALL POLYOLS

before you buy . . . and choose the one that proves superior on every count. To help you utilize sorbitol's unique characteristics in your product, Atlas offers full technical information and research service.

INDUSTRIAL CHEMICALS  
DEPARTMENT

**ATLAS**  
POWDER COMPANY

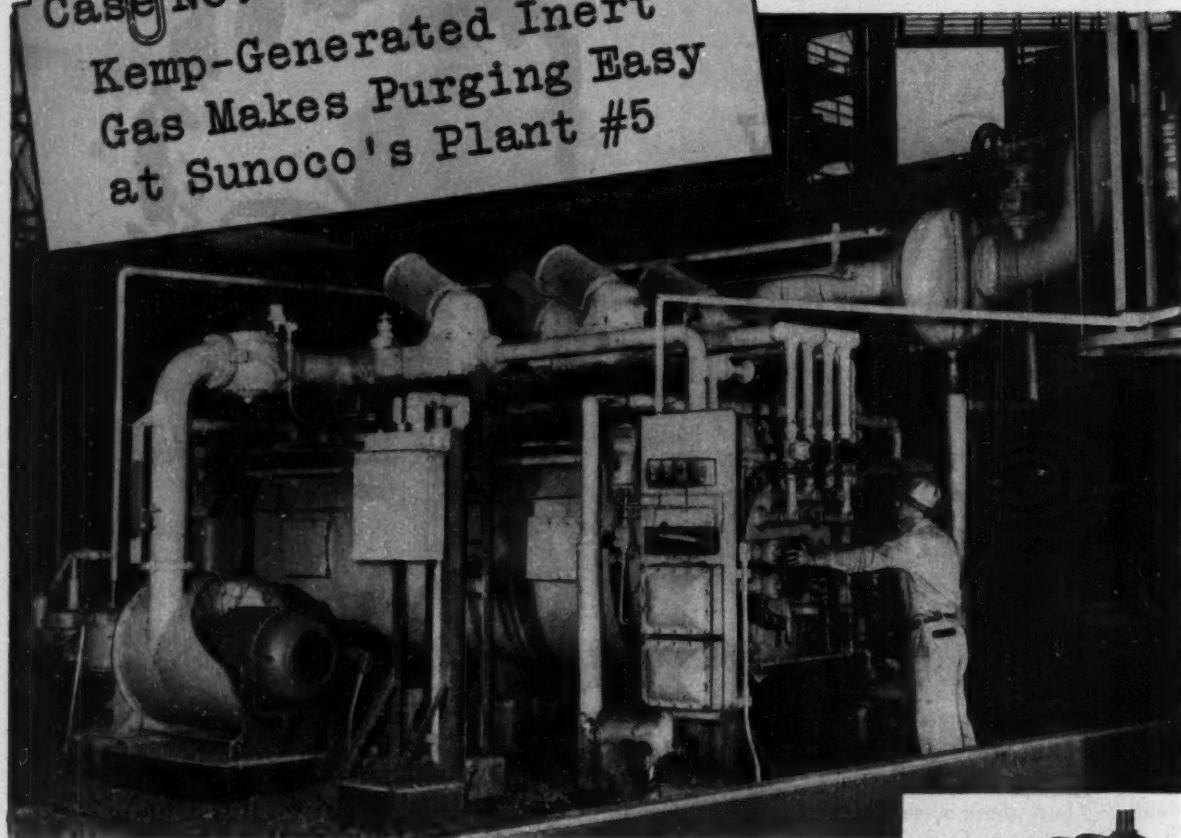
WILMINGTON 99, DELAWARE  
offices in principal cities  
ATLAS POWDER COMPANY,  
CANADA, LTD.  
BRANTFORD, CANADA

Write for the free booklet,  
"The Sorbitol Story," which highlights  
the reasons why sorbitol is a  
better product at a lower price.

ATLAS POWDER COMPANY • WILMINGTON 99, DELAWARE

Case No. 57

## Kemp-Generated Inert Gas Makes Purging Easy at Sunoco's Plant #5



## How Sun Oil's "Magic Mill" at Toledo operates with 'round the clock safety

There's no one word that strikes terror in the hearts of oilmen everywhere more quickly than F-I-R-E! To combat this threat at the Sun Oil Co.'s giant refinery at Toledo, Ohio, constant vigilance, checks and inspections are the answer. And the liberal use of inert gas for purging pipelines, tanks and crackers is essential to this safety maintenance.

### Kemp selected to do the job

When plans called for *doubling* plant production in 1950, a new Kemp Generator (see above) was installed to insure adequate inert gas production. Fast-starting, easy-to-operate, this Kemp unit more than filled the bill. Today tanks and lines are periodically purged

for inspection and cleaning *as often as needed*. And thanks to its 60,000 cu. ft. per hr. Kemp Inert Gas Generator, Sunoco enjoys exact *analysis* inert production that meets all its purging requirements.

### Let Kemp help you, too

If you have a purging or blanketing problem, why not let Kemp Engineers give you the same helpful advice used so profitably at Sun Oil's Toledo refinery. It costs you nothing to investigate. And it may save you money. Find out how Kemp's wide range of dependable, low-cost Generators (complete with the latest fire checks and safety devices) offer you the best way to solve your problems.

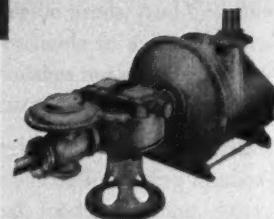
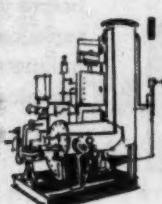


Photo above shows close-up view of Kemp Industrial Carburetor, the heart of every Kemp installation. Assures complete combustion...without waste, without tinkering. Reduces installation costs, simplifies maintenance.

For more complete facts and technical information, write for Bulletin I-10 to:  
**C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland.**

**KEMP**  
OF BALTIMORE



### INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS  
METAL MELTING UNITS • ABSORPTIVE  
DRYERS • SINGEING EQUIPMENT



## Why leading cooling tower manufacturers specify Aeromaster Fans

- Adapted high-speed, top-efficiency aircraft propeller design
- Engineering service for special installations
- Longer life—improved anti-flutter performance
- Saves in power costs—requires less horsepower
- Each blade precisely pre-balanced
- Easily assembled by unskilled labor
- Aeroloid blade coating protects blades against mild acids and alkalies, abrasion, all weather conditions
- Blade pitch easily adjustable to meet changing power requirements
- Specified as original equipment by many manufacturers
- Sales engineers available in principal cities

Koppers Aeromaster Fans are available for diesel motors, pumping stations, chemical processes, air-conditioning systems—any sizable industrial cooling requirement. Standard models range from 5 to 24 ft. diameters, with 4, 6, or 8 blades per fan. Capacities up to 1,000,000 cubic feet of air per minute. Every fan is fully guaranteed.



## Aeromaster FANS

Manufactured by the Metal Products Division of Koppers Co., Inc., which also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators and Gas Apparatus.

Engineered Products Sold with Service

MAIL COUPON TODAY FOR COMPLETE INFORMATION

KOPPERS COMPANY, INC., Aeromaster Fans  
234 Scott St., Baltimore 3, Md.

Gentlemen: Please send me detailed information on Aeromaster Fans for

(name and type of equipment to be cooled)

Name \_\_\_\_\_  
Title \_\_\_\_\_  
Company \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## ONE CONTROL DOES THE JOB OF TWO

Mercoid DA-400 Series Pressure Controls incorporate a single bournon tube which actuates two independently adjustable Mercoid magnet operated mercury switches to accomplish various circuit operations. For example:

- 1. Close one alarm circuit at high pressure and another at low pressure with both circuits open over operating range.
- 2. As an electrical interlock to open one circuit as pressure rises above and the second circuit as the pressure drops below operating range.
- 3. To provide two-stage control by opening or closing one circuit on a rise in pressure and the second circuit on a further rise in pressure.



Ranges 0-30" to 300-2500 psi

Write for Bulletin 5P

THE MERCOID CORPORATION  
4301 READING ROAD, CINCINNATI 3, OHIO

**SAVE UP TO 80%**  
**OF WORK CLOTHES COST!**

**WORKLON** industrial apparel of  
ACID RESISTANT DU PONT ORLON



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FREE Rush WORKLON'S new and fully illustrated  
16 page catalog of ORLON and COTTON WORK CLOTHES  
Firm Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_  
Attention of \_\_\_\_\_ Dept. \_\_\_\_\_

PROJECT  
MANAGEMENT  
DESIGN  
CONSTRUCTION  
MANUFACTURE

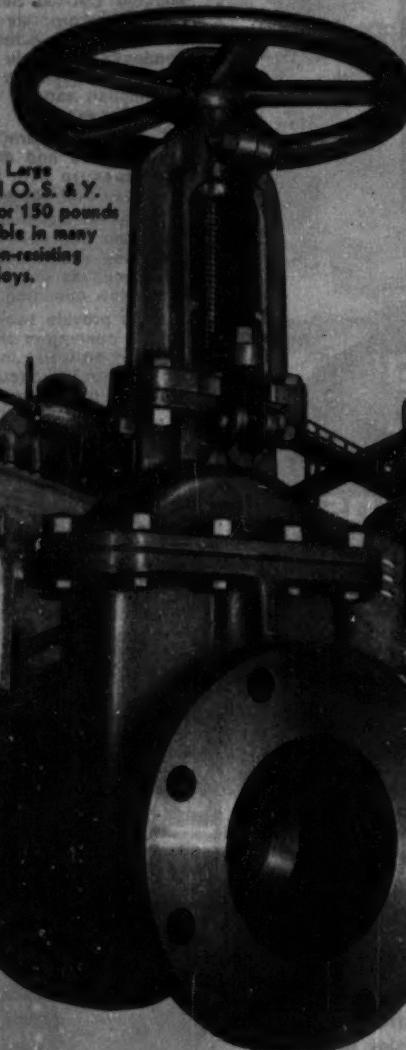


Fig. 2452-G. Large  
Stainless Steel O. S. & Y.  
Gate Valve for 150 pounds  
W. P. Available in many  
other corrosion-resisting  
metals and alloys.

## The name "POWELL" on a valve assures absolute dependability

Naturally, in buying a valve, the first consideration is its ability to perform a specific service. But that is not all. For it must also be a valve that will continue to function dependably for a long time. Powell Valves have an established reputation for such dependability.

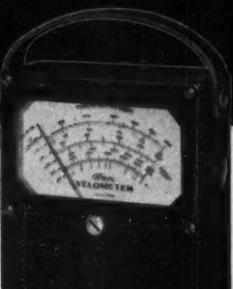
The Wm. Powell Co.  
Cincinnati 22, Ohio

# POWELL

BRONZE,  
IRON, STEEL AND  
CORROSION-RESISTING VALVES



**READ AIR  
VELOCITIES**  
*instantly...  
accurately...  
anywhere...*



...WITH THE  
**ALNOR  
VELOMETER**

Alnor Velometer, a precision-built, self-contained, portable instrument, gives you instant, accurate readings of air velocities anywhere—in plants, mines, mills or laboratories. Measures speed of air flow through ducts, grilles, furnaces, spray booths or in the open. This rugged instrument needs no special care or delicate handling—anyone can use it and get accurate readings. Need no calculations or reference charts. Available in a wide variety of scale ranges, and with a full assortment of jets and fittings for every application. You'll want full details and prices, so write for Bulletin 2448-G, Illinois Testing Laboratories, Inc., Room 559, 420 No. La Salle St., Chicago 10, Ill.

*Alnor*

**PRECISION INSTRUMENTS  
FOR EVERY INDUSTRY**

**Pocketsize\*  
Performance**



\*22 in. x 25½ in.

...with big equipment accuracy...that's Sutton's new

**Whippet V-80**

**Specific Gravity Separator**  
designed especially for small lot operations!

Now for the first time in separating equipment history here is a portable lab-size separator, incorporating all the inherent performance qualities of standard size machines. Now for the first time you can economically assay products for accurate "commercial yield" data before setting up full-scale processing operations.

There's a lot you'd like to know about Sutton's new Whippet V-80. There's a lot we'd like to tell you.

Write Dept. C353

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1031 SOUTH HASKELL • DALLAS, TEXAS**

SALES AND SERVICE: DALLAS • COLUMBUS, GA. • NEW YORK • PITTSBURGH • CHICAGO  
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FOREIGN: WINNIPEG, CANADA • SAO PAULO, BRAZIL • LONDON, ENGLAND

**SUTTON**

**STEELE &**

**STEELE, INC.**

**BAG CLOSING MACHINES  
FOR EVERY NEED . . .**



**...from UNION SPECIAL'S  
Complete Line! . . .**

FOR lower production costs . . . stronger, neater closures . . . ability to get out rush orders in a hurry, you can't beat Union Special Bag Closing Machines! Specially built to stand up under heavy production schedules, these machines provide the high output rates needed to meet modern competitive conditions.

In the Union Special line, it's easy to find the right unit to meet your particular requirements. **ASK FOR RECOMMENDATIONS.**

*Ask for  
Recommendations*

**UNION SPECIAL MACHINE CO.  
409 N. Franklin St., Chicago 10, Ill.**

**Gentlemen: Without obliging me, please furnish information on bag closing equipment to handle the following production:**

**Kind of bags used? \_\_\_\_\_**

**Filled weight of bag? \_\_\_\_\_**

**Material being packed? \_\_\_\_\_**

**Maximum bags per minute? \_\_\_\_\_**

**Check-weighing required? \_\_\_\_\_**

**Conveyor required on Machine? \_\_\_\_\_**

**Power:  D.C.,  A.C., Volts \_\_\_\_\_**

**Phase \_\_\_\_\_ Cycles \_\_\_\_\_**

**Name \_\_\_\_\_**

**Company \_\_\_\_\_**

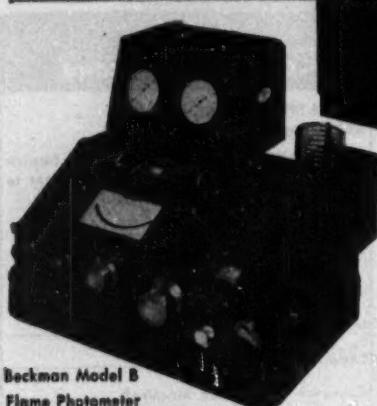
**Address \_\_\_\_\_**

**ONE COMPANY SAVES \$300  
A WEEK PER INSTRUMENT!**

**Have YOU investigated  
the savings possible  
with Beckman  
Flame Photometry?**

**Applications are many and varied!**

Flame Photometry (the determination of elements by their flame spectra) is rapidly moving to the forefront as one of the most useful of all instrumental methods of analysis—so rapidly, in fact, that many potential users are not yet aware of the great savings to be made by this time-saving analytical tool. Yet companies that have investigated Beckman Flame Photometry are finding it amazingly profitable. One oil company reports savings of \$300 per week per instrument... a bottle manufacturer reduced analysis time from 36 hours to 2 hours... a municipal water treating plant has solved an important control problem other methods could not satisfactorily handle... a fruit processing plant has greatly simplified its control of flavor and quality... and many other companies in widely-varying industries are finding new profits, new savings with Beckman Flame Photometry methods.



Beckman Model B  
Flame Photometer

**How Savings Are Made...**

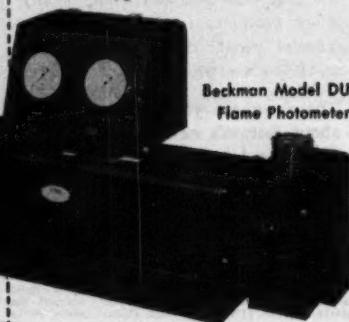
The Beckman Flame Photometer analyzes virtually any aqueous or non-aqueous solution for metals and metallic compounds (quantitatively and qualitatively) at rates as fast as 10 seconds per determination—with greater accuracy than other methods.

It will quickly make determinations that other routine methods cannot handle—and is applicable to an unusually wide range of industrial, medical and laboratory processes.

Typical fields of application include analysis and control of brine solutions, beverages, cement, glass, metallurgy (ferrous and non-ferrous), fertilizers, soils, fruits, grains, vegetables, petroleum products, power plant processes, municipal water treatment, biologicals and a great many others.

**Why Beckman Equipment...**

Beckman Flame Photometers use acetylene or hydrogen for a hot steady flame—not obtainable with city gas. Direct aspiration of sample into the Beckman flame means faster response, steadier readings and smaller sample consumption. Use of a Beckman Monochromator instead of glass filters provides higher resolution and sensitivity, permitting analysis of many types of samples that cannot be satisfactorily determined on filter type instruments.



Beckman Model DU  
Flame Photometer

**Let us give you complete data.**

To better acquaint you with the many profitable applications for Beckman Flame Photometers, we have prepared a helpful data file which outlines applications, methods and equipment. See your nearest Beckman Instrument dealer for free data.

Or write direct for Data File # 20-14

**BECKMAN INSTRUMENTS**  
control modern industries

**BECKMAN INSTRUMENTS INC.**  
SOUTH PASADENA 1, CALIFORNIA

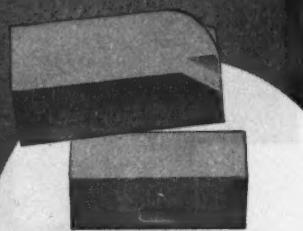
Factory Service Branches: Chicago—New York—Los Angeles

Beckman Instruments include: pH Meters and Electrodes — Spectrophotometers — Radioactivity Meters — Special Instruments

**McDANEL**

**HIGH  
DENSITY PORCELAIN**

- MILL LINING
- SPECIAL SHAPES
- TANK LINING



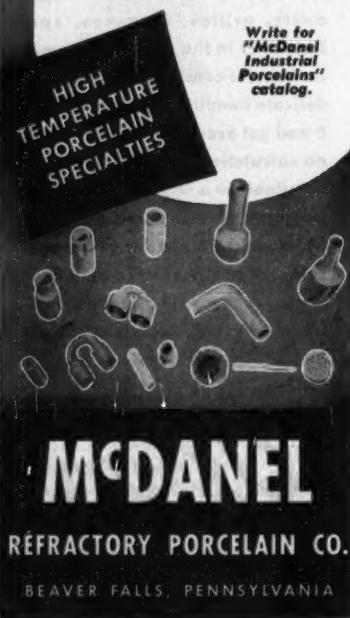
**MORE PRODUCTION  
LONGER LIFE  
LESS CONTAMINATION  
LESS DOWN TIME**

McDaniel Super High Density Lining Brick in routine production is giving better than two times longer life over conventional porcelain lining.

That's why — for hard, tough grinding — you should line your grinding mills with McDaniel High Density Brick.

This high density brick — for all types of ball mill grinding — comes in a complete range of sizes to fit all types of batch or continuous mills.

Write for  
"McDaniel  
Industrial  
Porcelains"  
catalog.



**McDANEL**

**REFRACTORY PORCELAIN CO.**

BEAVER FALLS, PENNSYLVANIA



*Solve...*  
TOUGH CONTROL and  
DRIVE PROBLEMS

with **IR** AIR  
**MOTORS**

Here is a typical problem. . . Ingersoll-Rand Air Motors solved this tough control problem in a paper mill. Since steam and acid conditions prevailed, manual operation of digester dump valves was extremely dangerous. These conditions also prevented satisfactory use of electric motors and controls. Size 55SM Air Motors were installed, dumping was controlled from the charging floor 50 feet above the dump valves, and stand-by valve crews were no longer necessary, due to the reliable, trouble-free operation of the Ingersoll-Rand Air Motors.

When wide ranges of operating speeds are desired . . . when instantaneous starting and stopping is needed . . . when the motor will be subjected to frequent stalling and overloads . . . when wet, acid, or explosive atmospheres, or high temperatures make operations too hazardous for direct manual control . . . when expensive and complicated protection devices would otherwise be required . . . when compact motor units are essential . . . and finally, when installation and maintenance costs must be kept low . . . the Ingersoll-Rand Air Motor is the answer to the problem.

Write, wire, or phone your nearest Ingersoll-Rand branch office for help with your tough control and drive problems . . . or request the new Air Motor Bulletin, Form 5072, which gives full information on over 110 sizes of Air Motors . . . both Piston and Multi-Vane types . . . speeds from 5400 to 19 r.p.m. . . . from 1 to 24 H.P. . . . or request information on fractional horsepower Air Motors.

# Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

836-8

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES  
CHEMICAL ENGINEERING—April 1953

# You've got a Winning Combination



With the New

TRADE  
**LESLIE**  
MARK

## DOUBLE SEATED DIAPHRAGM CONTROL VALVES

Calling a spade a spade you've got a "royal flush" of features in these new Valves designed for use with control instruments.

Their "Flow-Line" Contoured Bodies have ISA standard face-to-face dimensions and high capacity, low turbulence and minimum body pressure drop characteristics.

A new type, top and bottom guided construction is self-aligning and non-binding regardless of unevenness of bolt tightening.

Standard, integral stellited seating surfaces are recommended for steam service to reduce seat ring thread corrosion. Renewable, interchangeable seat rings also furnished where desired and may be easily replaced without removing valve body from the line. Elaborate grinding at high temperatures is completely eliminated.

With these Valves, you get as standard equipment, features heretofore only obtainable in expensive, specially designed valves.

Look for LESLIE REGULATORS under "Valves" or "Regulators" in your classified telephone directory in the following cities where LESLIE factory trained engineers are located:

Albany, N. Y.	Chicago, Ill.	Galveston, Tex.	Memphis, Tenn.	Orlando, Fla.	Salt Lake City, Utah
Albuquerque, N. M.	Cincinnati, Ohio	Greenville, S. C.	Miami Springs, Fla.	Philadelphia, Pa.	San Francisco, Calif.
Atlanta, Ga.	Cleveland, Ohio	Houston, Texas	Milwaukee, Wis.	Pittsburgh, Pa.	Seattle, Wash.
Baltimore, Md.	Dallas, Texas	Indianapolis, Ind.	Minneapolis, Minn.	Ponca City, Okla.	St. Louis, Mo.
Beaumont, Tex.	Denver, Colo.	Kansas City, Mo.	Mobile, Ala.	Providence, R. I.	Syracuse, N. Y.
Birmingham, Ala.	Des Moines, Ia.	Kingsport, Tenn.	Monroe, La.	Richmond, Va.	Tucson, Ariz.
Boston, Mass.	Detroit, Mich.	Los Angeles, Calif.	New Orleans, La.	Rochester, N. Y.	Wilkes-Barre, Pa.
Bridgeport, Conn.	El Paso, Tex.	Louisville, Ky.	New York, N. Y.	Rutherford, N. J.	Wilmington, Calif.
Buffalo, N. Y.					Youngstown, Ohio

Brussels-Forest, Belgium

WRITE FOR Bulletin 513

ESTABLISHED 1900

**LESLIE**  
CO.

1707

FLOATLESS LEVEL CONTROLS  
SELF CLEANING STRAINERS

PRESSURE REDUCING VALVES	•	PRESSURE CONTROLLERS
• PUMP GOVERNORS	•	TEMPERATURE REGULATORS
• AIR HORNS	•	STEAM WHISTLES

279 Grant Avenue, Lyndhurst, New Jersey

# CHIKSAN takes a Compressor's Pulse

**Keeps Gas Flowing—  
Absorbs Vibration of  
Changing Pressures**



Not only do the stamina and flexibility of Chiksan Joints take expansion in their stride, they absorb pulsation and vibration. When the Plymouth Oil Company wanted a better way to handle the expansion and contraction of its 2500-3500 lb. natural gas re-pressuring line in its compressor station in Sinton, Texas, back in 1946, it tried Chiksan 2-inch high pressure ball bearing swivel joints. So successful were Chiksan Joints in this application, they were adopted for 3 and 4-inch lines for the same purpose. In addition, by placing regulators, gauges and other recording equipment on a bridge

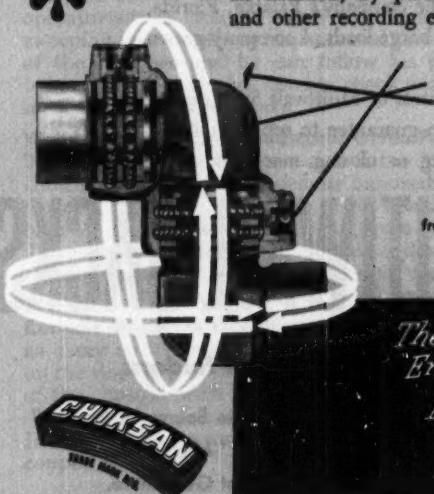
using Chiksan Joints, accurate readings of the instruments could be obtained.

Since 1946, not one of these Chiksan Joints has been replaced or even repacked, and they are giving the same economical, dependable service they did when first installed.

In Texas or California — all over America and all around the world — wherever production, processing or distribution depends on the flow of liquid or gas or on the dependability of hydraulic systems, there you will find Chiksan Ball Bearing Swivel Joints on the job — adding muscle and flexibility — cutting down on shut-downs and maintenance.

Whatever your business, if gas or liquid plays a part, Chiksan's Research and Development Division can help you add efficiency, safety and economy to your operation.

Representatives in Principal Cities  
Write for Catalog 53-C, Dept. CE-4.



CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry — with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles and sizes have been developed for pressures and services from 20" vacuum to 15,000 psi and for temperature ranges from minus 75° to a plus 500° F. with packing materials for each specific type of service.

The Flow of  
Enterprise  
Relies on

# CHIKSAN

Ball Bearing  
Swivel Joints

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 28, Illinois • Newark 2, New Jersey  
Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Chiksan Export Company (Subsidiary), Brea, California • Newark 2, N. J.



Hudson foresters choose a stand of prime timber for multiwall Kraft from Hudson's 435,000 acres. They practice selective harvesting, always leaving parent trees to help with the new crop, by natural reseeding.



Careful selection of trees for mechanized cutting gives uniform quality and dependable supplies of raw materials for pulp making.



Every year about 1½ million southern pine seedlings are planted on Hudson tree farms.

## Here is why **HUDSON** can guarantee Multiwall Sacks against breaking on the packer

### REASON NUMBER 1 → **HUDSON GROWS ITS OWN TREES**

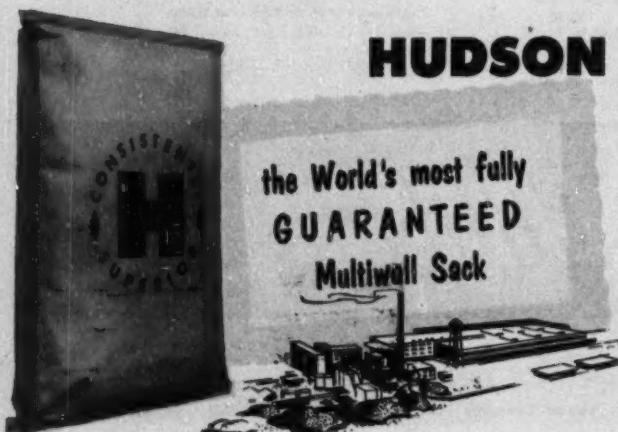
Tree farming is big business with Hudson. Every month the company's Palatka, Florida, mill converts 620 freight carloads, 2,515 truck loads, and 10 barge loads of company-grown pine into long-fiber Kraft.

By growing its own trees, Hudson can exert iron-clad control of Multiwall Sack quality and delivery schedules. This is one reason why Hudson can guarantee to replace *without cost* all Hudson Multiwall Sacks that fail on your packing or closing machines.

**HUDSON**

# MULTIWALL SACKS

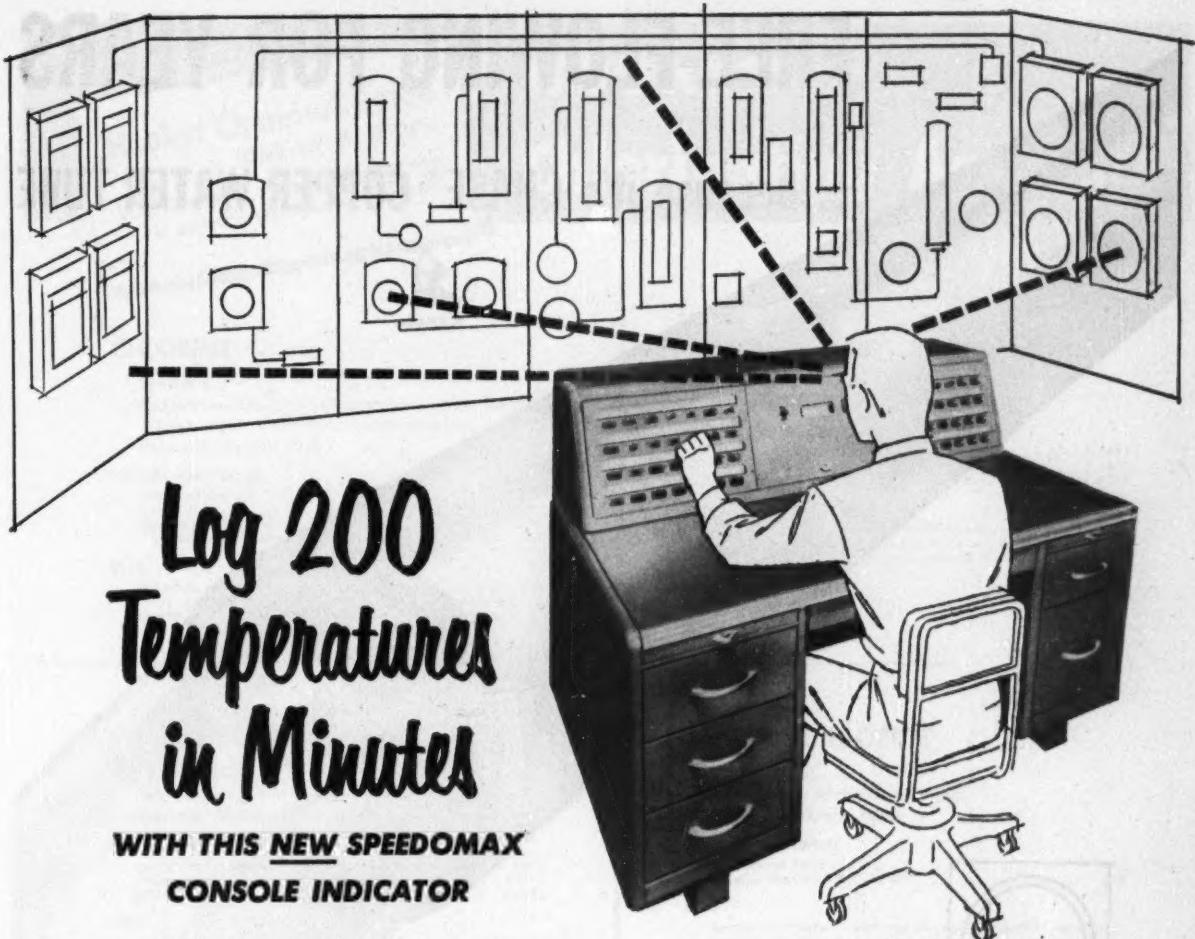
the World's most fully  
**GUARANTEED**  
Multiwall Sack



**Send for these 3 helpful folders:**

"Avoid Breakage," "Dependable Source of Supply," and latest issue of "Sack Sense." Also full details on Hudson's unusual Replacement Guarantee. No obligation.

**HUDSON PULP & PAPER CORP.,  
Dept. 135, 505 Park Ave., New York 22, N.Y.**



# Log 200 Temperatures in Minutes

**WITH THIS NEW SPEEDOMAX  
CONSOLE INDICATOR**

Here is a trim equipment that helps even the most modern control room to streamline its appearance and operation. This new Speedomax Console Indicator lets an operator scan up to 200 temperatures as fast as he can log them. What's more, the console extends only 13" above the desk, for an easy, no-stretch view of the main panel. Even when the operator sits as close as 6 or 8 feet from the panel, he has a sweeping view of all instruments and flow diagrams. A touch of the switches and he can follow his process during heat balance checks. He can quickly check panel recorders or spot non-recorded temperatures.

**Well-Known Electronic Indicator Gives Fast, Easy Readings:** The focal point of this new unit is the Model D Speedomax Indicator that is being used in hundreds of plants. In the Console Indicator, the front of its housing slopes at 60° to help an operator read the 25½" drum-type scale with ease. The scale is direct-reading for single or double ranges. It spins rapidly from point to point and stops "dead still." Balancing time is only 4 seconds full-scale, 2.5 seconds half-scale.

**Console Design is Functional and Neat:** Legend holders and as many as 100 toggle or 96 push-button switches all mount on the sloping panels. Terminal boards are in the roomy back of the console, with big doors for easy access. A large duct conceals all external leadwires. The Speedomax Console Indicator can streamline your control room now. Send the coupon today.

**LEEDS & NORTHRUP**  
INSTRUMENTS  
NORTHROP  
automatic controls • furnaces

#### CHECK THESE FEATURES:

- ✓ Toggle switches permit up to 200 Indicator readings or 100 Indicator and Recorder readings; push-button switches connect as many as 96 Indicator points.
- ✓ Console Indicator saves panel space.
- ✓ Speedomax Indicator slides out of console on tracks; switching panels are removable.
- ✓ For easy identification of points, legend strip holders mount next to switches . . . toggle switch handles can be color-coded.
- ✓ Signal lights, indicating gages, etc., can be mounted on unused switching panel space.
- ✓ Height of the executive-style desk adjusts from 29" to 30½".

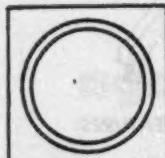
LEEDS & NORTHRUP COMPANY  
4916 Stanton Ave., Philadelphia 44, Pa.  
 Send your folder on the Speedomax Console Indicator.  
 I'd like to increase speed of logging with the Speedomax Console Indicator. Have an L&N engineer contact me.

Name \_\_\_\_\_  
 Title \_\_\_\_\_ Dept. \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_

Jrl. Ad ND46-33A(3)

# FREE-FLOWING FOR YEARS

...because it's CHASE® COPPER WATER TUBE



Chase Copper Tube keeps a clean, clear cross-section, even after years of service in a paper mill.



Get pipe that can't rust up inside. Chase Copper Water Tube keeps repair and pumping costs down.

**PROCESS LINES** give years of trouble-free service when you use Chase Copper Water Tube.

Chase Tube is corrosion-resistant, it can't clog with rust. Used for your process lines, it delivers full flow even for heavy industrial fluids like paper pulp. That means a big saving in pumping costs.

Chase Copper Water Tube installed with Chase Wrought Solder-Joint Fittings makes an assembly that has very low flow resistance. It will pay you to find out about Chase Copper Water Tube.

# Chase

BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

*The Nation's Headquarters for Brass & Copper*

Albany †	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver †	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston	Newark	Rochester †	
Cincinnati	Indianapolis	New Orleans	St. Louis	(† sales office only)

**Hooker Chemical Guide**  
(ONE OF A SERIES)

USE this handy reference to save time  
in selecting high-quality chemicals.

# HOOKER

## Chlorinating Agents

### CHLORINE

Symbol: Cl<sub>2</sub>

Appearance: Greenish-yellow gas at ordinary temperatures; amber liquid when under pressure

Molecular Weight: 70.9

#### TYPICAL PROPERTIES

Freezing Point .....	-100.98°C
Boiling Point .....	-34.5°C
Specific Gravity, Gas at 0°C (Air=1) .....	2.49
Liquid at 20°C (Water=1) .....	1.41

#### USES

Bleaching pulp and paper, water purification, sewage treatment, general germicide and deodorant. Manufacture of organic and inorganic chemicals; and many other uses.

### SULFUR MONOCHLORIDE

Formula: S<sub>2</sub>Cl<sub>2</sub>

Appearance: Yellow to slightly reddish heavy liquid

Molecular Weight: 135.0

#### TYPICAL PROPERTIES

Last Crystal Point .....	-80°C
Boiling Point .....	138°C
Specific Gravity, 15.5°/15.5°C .....	1.6885

#### USES

Chlorinating agent; for organic chemicals, rubber substitutes, etc.; polymerization catalyst; reagent in manufacture of military gases, insecticides, chemical intermediates, phenolic resins, other chemicals; solvent for sulfur.

### SULFURYL CHLORIDE

Synonym: Sulfuric Oxychloride

Formula: SO<sub>2</sub>Cl<sub>2</sub>

Appearance: Light yellow liquid

Molecular Weight: 135.0

#### TYPICAL PROPERTIES

Pour Point .....	below -54°C
Distillation Range .....	2° including 69.5°C
Specific Gravity, 15.5°/15.5°C .....	1.680

SO<sub>2</sub>Cl<sub>2</sub> Content .....

99%

#### USES

Chlorinating agent; for the production of chlorophenol, chlorthymol, pharmaceuticals, dyestuffs; reacts with sodium salts of organic acids to form chlorides and anhydrides.

For detailed information on items listed, drop us a note on your letterhead. Address your request to HOOKER ELECTRO-CHEMICAL COMPANY, 5 Forty-Seventh St., Niagara Falls, N. Y.

— From the Salt of the Earth —

**HOOKER ELECTROCHEMICAL COMPANY**

NIAGARA FALLS • TACOMA • NEW YORK • CHICAGO • LOS ANGELES

### MURIATIC ACID

Appearance: Hooker White Grade—Colorless  
Commercial Grade—Light yellow

#### TYPICAL PROPERTIES

Specific Gravity, 15.5°/15.5°C .....	18° Be' ..... 1.1417
20° Be' .....	1.1600
22° Be' .....	1.1789

#### USES

In manufacture of dyestuffs; refining ores, pickling and cleaning metals; manufacture of foodstuffs and pharmaceuticals; in textile dyeing and finishing; in general chemical manufacture.

### SULFUR DICHLORIDE

Formula: SCl<sub>2</sub>

Appearance: Brownish-red liquid

Molecular Weight: 103.0

#### TYPICAL PROPERTIES

Last Crystal Point .....	-78°C
Specific Gravity, 15.5°/15.5°C .....	1.638

#### USES

Special chlorinating agent and chloridizing agent in metallurgy; reagent in the manufacture of organic acid anhydrides, organic chemicals, insecticides, rubber cements, rubber substitutes, treatment of drying oils for varnishes; drying agent for coatings of ink, paint or varnish; as a replacement for sulfur monochloride where higher chlorine content is desired.

### THIONYL CHLORIDE

Synonym: Sulfurous Oxychloride

Formula: SOCl<sub>2</sub>

Appearance: Clear, pale yellow to red liquid

Molecular Weight: 119.0

#### TYPICAL PROPERTIES

Pour Point .....	below -75°C
Distillation Range .....	High Grade ..... 75° to 78°C
..... Tech. Grade .....	72° to 79°C
Specific Gravity, 15.5°/15.5°C .....	1.640

SOCl<sub>2</sub> Content .....

99%

High Grade .....

95%

Tech. Grade .....

95%

#### USES

Chlorinating agent; to replace various groups with chlorine to form acid chlorides and anhydrides. Among end products are: isoamyl chloride, synthetic pyrethrum, phenyl propyl chloride and synthetic vitamin A palmitate; antihistamines.

**HOOKER**  
**CHEMICALS**



## *It's the Nash!*

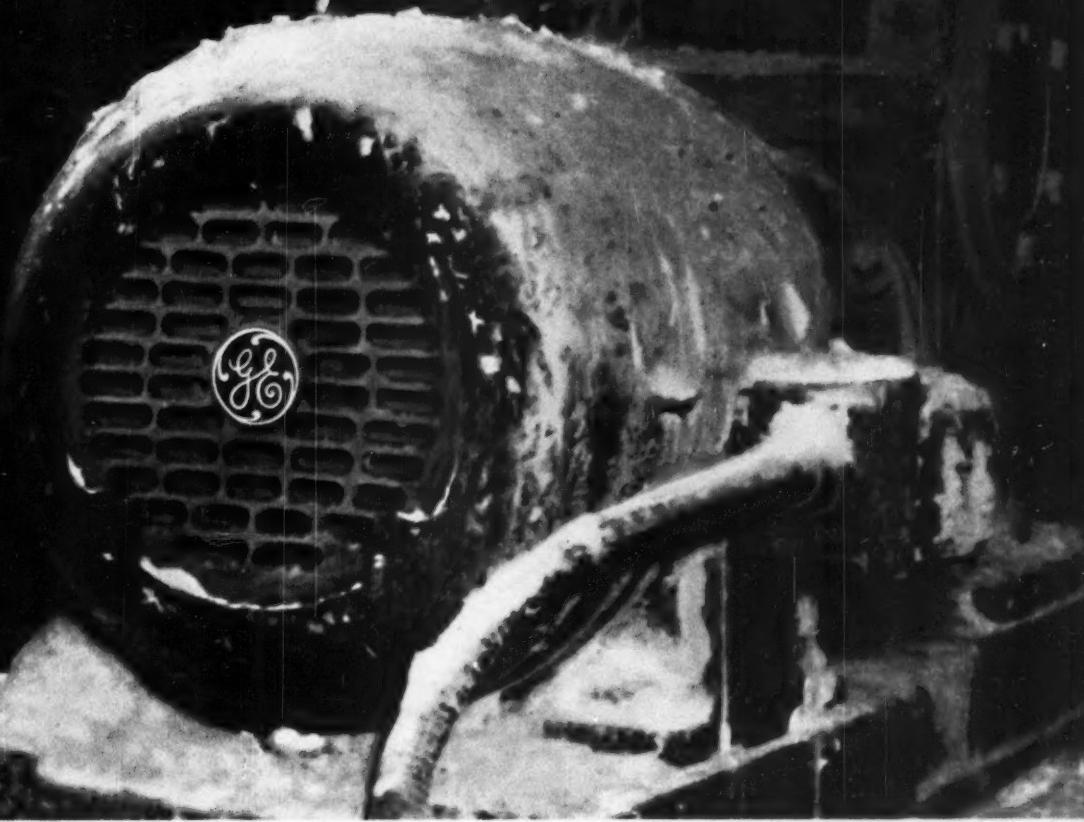
The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

**NASH ENGINEERING COMPANY**  
312 WILSON, SO. NORWALK, CONN.



## Corrosion won't hurt this **TRI-CLAD** motor's cast-iron frame

**HERE'S A COMMON SIGHT AROUND MANY PLANTS—**  
A G-E Tri-Clad motor operating reliably and continuously under the extremely corrosive conditions that cause many other motors to fail.

**THAT'S WHY YOU CAN EXPECT** superior performance from G-E Tri-Clad motors. Consider these facts:

**CORROSION-RESISTANT CAST-IRON** means longer motor life. Unlike steel, cast-iron resists corrosive pitting, even when the paint is chipped.

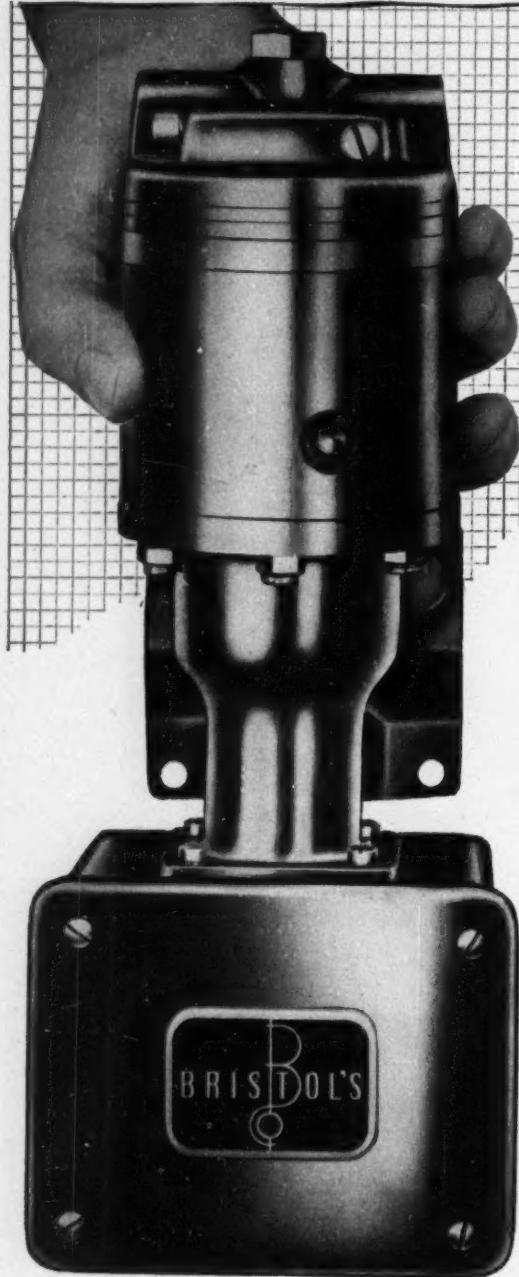
**RIGID, CAST STATOR FRAME** with integrally cast feet, can't be twisted out of line by accidental jarring or by excessive "bolt-down" pressure on the feet.

**STRONG, CAST-IRON END SHIELDS** have cast ribs for extra strength without adding extra weight . . . protect the true motor alignment even under heavy shaft loads.

**ORDER G-E TRI-CLAD MOTORS** from your nearby G-E Apparatus Sales Office or G-E Agent or distributor. General Electric Co., Schenectady 5, N. Y. 752-19

*You can put your confidence in—*  
**GENERAL** **ELECTRIC**

WHAT'S NEW AT BRISTOL . . . . . WHAT'S NEW AT BRISTOL



## New Bristol Series 650 PNEUMATIC TRANSMITTERS

for use with  
BRISTOL MINIATURE RECORDERS, INDICATORS, AND CONTROLLERS

... give you  
these new advantages

● **THEY USE BRISTOL WORLD-FAMOUS MEASURING ELEMENTS**—the measuring elements with wide-angle travel for positive action. These are the same standard Bristol measuring elements that are used in Bristol Recording and Controlling Instruments. They are the result of over 60 years of experience in instrument making and application in practically every industry. Bristol measuring elements are recognized the world over for their accuracy, simplicity, and reliability. There are no better measuring elements made than Bristol measuring elements.

● **TRANSMITTING UNITS PROVEN TO BE ABSOLUTELY RELIABLE AND TROUBLE-FREE.** They are very sensitive to extremely small changes in the measured quantity, as little as 0.03% of range, including reversal. Superior control results from the use of a booster valve with output capacity of 3.0 scfm.

● **SIMPLE TRANSMITTING MECHANISM—frictionless operation**—only one pivot and no flexures—will operate in any position—is weatherproof and can be installed in any location, pipe-saddle or surface mounting.

● **AVAILABLE IN A WIDE SELECTION OF RANGES:** Pressure (0 to 5" water to 0-10,000 psi), vacuum (0 to 5" water to full vacuum), temperature (-100° F. to 1000° F.), liquid level (0 to 5" water and up), flow (mercury manometer, bell type, and Barton meter bodies), and differential pressure (0 to 2.0" water to 0-500" water). Suppressed ranges available. Over-range is standard, up to 500% for some ranges. Write for free bulletin No. A105. The Bristol Company, 109 Bristol Rd., Waterbury 20, Connecticut.

6.3.8.

LOOK FOR OUTSTANDING NEW  
DEVELOPMENTS FROM BRISTOL

# BRISTOL

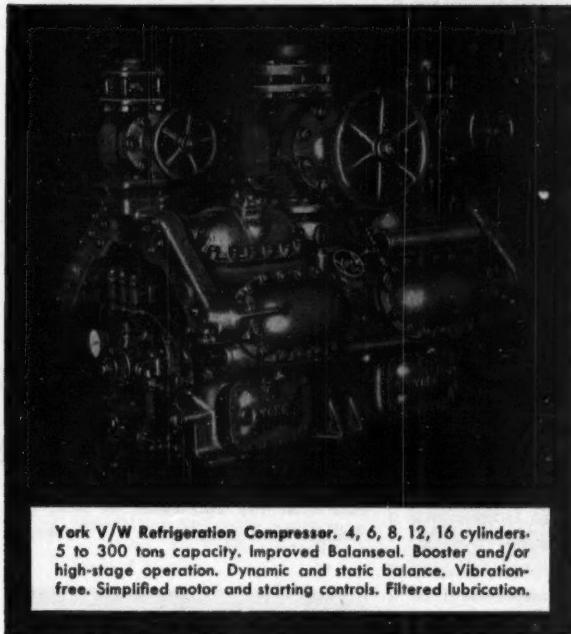
THE DEPENDABLE GUIDEPOST  
OF INDUSTRY

AUTOMATIC CONTROLLING, RECORDING AND TELEMETRIC INSTRUMENTS

# break the V/W volume Profit paradox

WITH YORK'S FAMOUS

# V/W COMPRESSOR!



**York V/W Refrigeration Compressor.** 4, 6, 8, 12, 16 cylinders. 5 to 300 tons capacity. Improved Balanseal. Booster and/or high-stage operation. Dynamic and static balance. Vibration-free. Simplified motor and starting controls. Filtered lubrication.

#### You'll Cut Costs With A York V/W Refrigeration Compressor

- 1. Low Initial Costs
- 2. Low Operating Costs
- 3. Space-Saving Compactness
- 4. Simplified Motors and Starting Controls
- 5. Low Maintenance Costs
- 6. Vibration-Free Operation
- 7. Filtered Lubrication
- 8. Positive Lubrication
- 9. Positive Shaft Seal
- 10. Booster and/or High-Stage Operation
- 11. Complete New Line

**1953 is a good year for you to plan capital investments.** Your treasurer knows that from now on profits will depend less on increased volume . . . more on equipment that will work harder, better, longer at lower cost.

*That's an accurate description of a York V/W Refrigeration Compressor.* Tough and durable, the York V/W Compressor has a low initial cost . . . saves you up to 72% power costs at 25% load . . . and is low in upkeep because every wearable part is easily and quickly replaced.

It allows you to utilize your present space more profitably because it takes up less area . . . needs no special foundations for upper floor mounting. You can utilize manpower and work-hours more profitably because you can schedule your loads with complete flexibility. Nor is York limited to a fixed capacity.

Consult your nearest York Representative today. He's listed in your phone book. He'll help you estimate the number and sizes of York V/W Refrigeration Compressors you need. Or write, if you prefer, to York Corporation, York, Pennsylvania.

# **YORK**

REFRIGERATION AND AIR CONDITIONING  
HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885



BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

# COPPER ALLOY BULLETIN



MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

## Stress Corrosion and Season Cracking in Condenser and Heat Exchanger Tubes

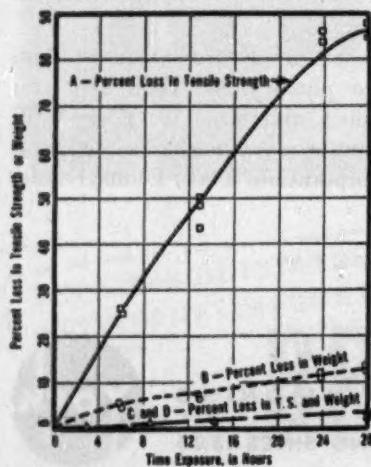
### PART I

Condenser and heat exchanger tubes made in accordance with A.S.T.M. Specification B 111 are generally supplied in the annealed condition with a medium to fine grain size. If properly handled, they are free from internal stresses. However, if they are subjected to applied stresses produced by high operating pressures or restraint of thermal expansion and contraction, or to residual stresses such as developed by overrolling, flattening, bending, denting, and rough handling, they may fail from either stress corrosion or season cracking when exposed to certain corrosive environments.

#### Factors Producing Stress Corrosion Cracks

Season cracking or stress corrosion of copper-base alloys depends upon the

Effect of Internal Stress on Corrosion of Yellow Brass (A and B) and 70-30 Cupro Nickel (C and D) Tubes in Concentrated Ammonium Hydroxide Vapors at 250°C.



following factors:

- (1) Composition of the atmosphere or liquid surrounding the stressed metal (ammonia, mercury and mercury salts are the biggest offenders).
- (2) Composition of the alloy.
- (3) Magnitude of the stresses.

The combined action of at least three substances: ammonia or ammonia-producing material (organic and inorganic substances containing nitrogen), water and oxygen usually are necessary to produce stress corrosion cracks in copper-base alloys. These three substances may be found where condensation of moisture from a gas, air or steam forms on the cool tube surfaces.

Oxygen and traces of ammonia from various sources may dissolve in the water film. The corrosion products which form under these conditions frequently are dark blue, black or dark brown with only a small amount of metal being corroded. Failure may develop within a few hours or after several years depending upon the magnitude of the stresses and the corrosive medium.

#### Influence of Alloy Composition

The resistance to season cracking and stress-corrosion cracking of copper-base alloys is influenced by their compositions. Briefly, alloys with higher copper content resist cracking better than low copper alloys. A simple procedure which graphically shows this difference in resistance to season

cracking consists of plotting the per cent loss in weight and the loss in tensile strength of corrosion test specimens against time of exposure to ammonia solution.

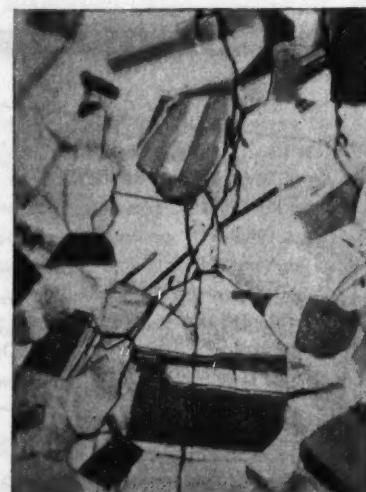
Typical curves for yellow brass (A and B) and 70-30 Cupro Nickel (C and D) are shown. The spread between the curves A and B, showing the per cent loss in tensile strength and weight, reveals the presence and intensity of season cracking. When no residual stress is present in brass, the tensile loss curve A becomes identical to the weight loss curve B, indicating that no cracking has occurred.

Curves C and D for highly stressed 70-30 Cupro Nickel show that the curves for loss in weight and for loss in tensile strength are identical, indicating freedom from stress corrosion cracking under these conditions.

#### Laboratory Assistance Available

Bridgeport's Corrosion Laboratory will welcome an opportunity to help you with any condenser or heat exchanger tube problem.

(9774)



Cracks resulting from stress corrosion in Admiralty metal. Mag. 500X.

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View above shows  
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Feeders in a bread crumb  
drying and grinding  
system using Prater Mills  
for primary and  
secondary reduction at a  
large mid-western bakery.

At left is a close-up  
showing simplicity of  
installation.

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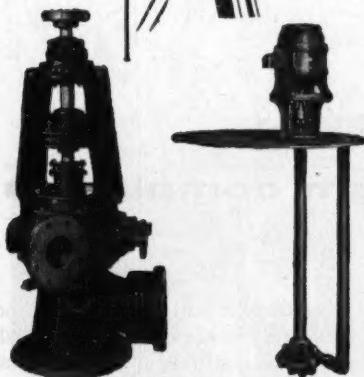
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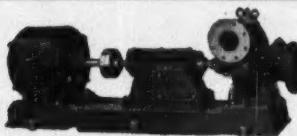
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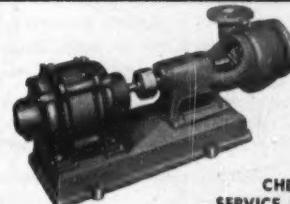
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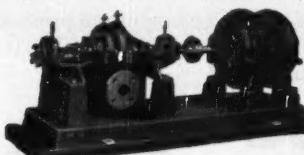
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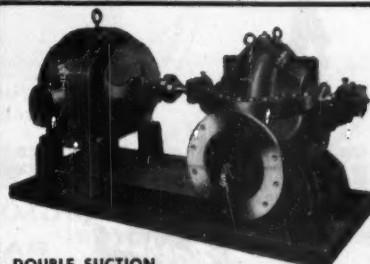
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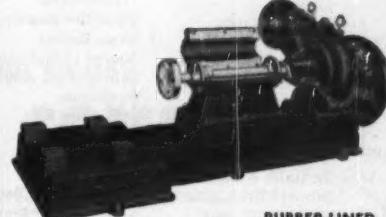
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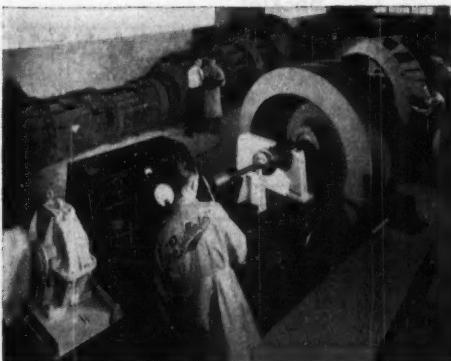
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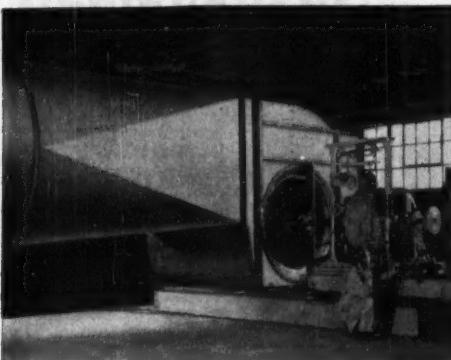
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- Urea Resins
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- Isonicotinic Acid
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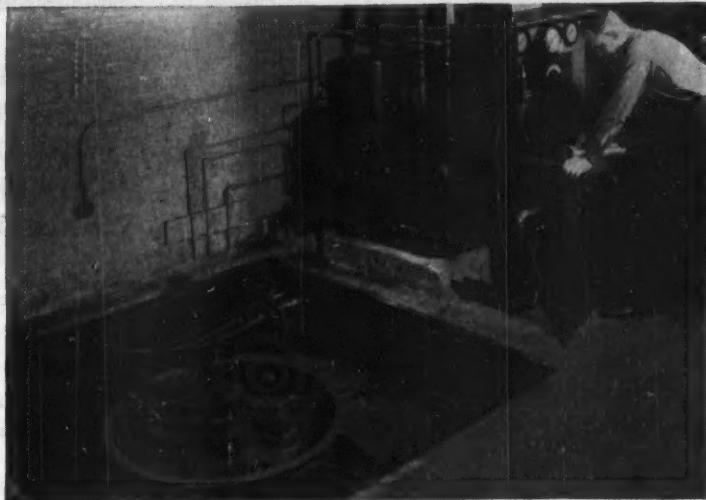
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Accurate testing assures rated performance of Buffalo Fans.



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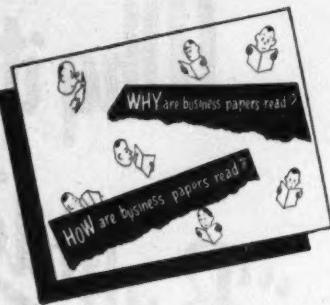
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**CHEMICAL ENGINEER**—broad experience administrative, sales and engineering work. Market surveys, process evaluation. Majored organic chemistry. Prefer New York area. Now unemployed. PW-7188, Chemical Engineering.

(Continued on page 468)

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Six years excellent experience as chief engineer of large Midwest processing plant. Not yet 35. Have supervised 10 man engineering department, installed nearly \$300,000.00 worth of electric, steam and processing equipment in recent plant modernization. B. S. M. E. with some specialized post-graduate work, plus over two years engineering and command duty afloat in the Navy. Presently employed in \$30,000 bracket but desire a top engineering position in the power or process fields on the West Coast, preferably in Northern California. Writes

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Large, established, nationally known company needs aggressive mechanical or chemical engineer to handle maintenance and engineering in one of its soap plants. Experience in maintenance and/or operation of soap and synthetic detergent production equipment desirable but not essential. Age 28-35. With reply include complete resume, recent photograph if available, and salary requirements.

P-7139, Chemical Engineering  
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### ASSISTANT SUPERINTENDENT

for Sugar Factory near large city in Canada

Requirements: Approximately 30 years of age, chemical or mechanical engineering degree, several years best sugar experience and possibly some knowledge of can sugar refining.

Good permanent position for qualified man, starting as soon as possible.

In application, which will be kept confidential, state present data, education, experience, references, remuneration expected and attach photograph.

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ASME Code Construction

Will gladly furnish estimates to your specifications.

#### FILTER EQUIPMENT

- 2—#12 Sweetland Filters for 36 leaves on 4" c.c.
- 8—Shriver 42" x 42", Iron Filter Presses, Plate & Frame, 18, 27, 36, 54 chambers, 1" cake.
- 18—Sperry 18" x 18", Iron, P & F, Filter Presses, closed delivery, 11 chambers.
- 1—American Disc Filter 6" dia., 2 disc, 100 sq. ft. filtering area, with auxiliaries.
- 1—Shriver, iron, steam heated, 30" x 30", 20 chambers, 1" cake.
- 1—8" x 12" Oliver Lead-Wood Vacuum Filter Acid-Resisting.
- 3—Oliver Vacuum Filters, incl. 8x12", 11 1/2" x 14", 11 1/2" x 18".
- 1—ALUMINUM Sperry FILTER PRESS, 30" x 30", 45 chambers, 1" cake.
- 1—Sperry 24" x 24" P & F Filter Press with 25 chambers, 2" frames.
- 1—#7 Sweetland Filter with 20 steel leaves, 4" c.c., NEW 1951.

#### DRY POWDER MIXERS

- 1—Kilby Jacketed Horiz. Ribbon Mixer, 450 cu. ft. capacity.
- 1—Day 5000# Horiz.; 1—Sturtevant 2000# Rotary; 1—Howes 1800# dbl. ribbon;
- 1—Munson Rotary 1000# batch; 1—Ransome 1/2 ton; 1—Hendee Ribbon 700#; 1—Day 400#.

#### PRICED TO SELL

- 5—Devine #28 Vacuum Shelf Dryers, each 20 shelves 59" x 78", surface condensers and vacuum pumps.
- 2—Ball & Jewell #2 Rotary Cutters.
- 1—Tothurst 48" steel basket Centrifugal, susp. type, bottom discharge.
- 4—Traylor Tube Mills, 5' x 22', 5' x 20' 4 1/2" x 18 1/2", 4' x 13'; each stone-lined, scoop feed, pebble charge, clutch pulley.
- Still installed in one plant as operated with all accessories as used.

#### ROTARY KILNS & DRYERS

- 2—7'x60' Calciners, made by Struthers Wells. Each 9 1/2" shell, Timken roller bearing supports, F-B gear reducer, with V-belted AC motor, firing hood, seal ring, all in excellent condition and priced for quick action.
- 2—Vulcan Iron Works 6'x80', complete, each with 3'x50' Rotary Cooler.
- 1—7'8"x125"; 1—8"x135" Allis Chalmers Rotary Kilns.
- 1—4'6"x35' Calciner, by Ruggles-Coles Co., complete.
- 1—6'6" L.D. 12' Rotary Nodulizer, 4 1/2" shell, Timken roller bearing rolls, gear reducer and motor drive.
- 4—Ruggles-Coles Direct Heat Rotary Dryers—Class XF—54" x 35", 1 Class XF 5'x40'. Also L.D. 27" x 10', Roto Louvers, three 3'x30'; 5'x30'; 5'x30'; 6'x40'; 6'x40'; 7'x70'.
- 1—8"x54" Direct Heat Rotary Dryer; Struthers Wells Co., with Timken roller bearing support, L-B gear reducer, 40 hp. motor, Coen burner, etc.
- 3—6'x50' Louisville Rotary Steam Tube.
- 1—4"x66" Fisher or Cooling Roll.
- 1—5'x33' Rotary Vacuum Dryer, jacketed shell; 1—20"x28", jacketed, with dust collector and condenser.

#### EVAPORATORS

- 1—Quadruple Effect Evaporator, calandria type, brass tubes, 14,000 sq. ft. H.S., excellent condition; still erected; complete with piping, etc.
- 3—Mojonier S/S Vac. Pans, 3', 4', 5', 6'.

#### JACKETED KETTLES

- 2—Patterson Foundry 500 gal. steel jacketed closed agitated Vacuum Pans or Kettles.
- 1—Stainless Lee 300 gal. Style A.
- 6—Dopp C.I. 80, 100, 150, 350, 600 gal.
- 7—Steel, agitated, 350, 500, 700, 800.
- 3—8500 gal., welded, agitated, open.
- 3—Aluminum and Copper, 30 gal. to 800 gal., some agitated.

#### HIGH SPEED MILLS

- 6—J. H. Day type B, 14" x 30", 3 roll High Speed Roller Mills, with all roller bearings and watercooled rolls—silent chain drive.

#### DOUBLE DRUM DRYERS

- 1—42" x 120" Buflovak Atmospheric S/S Conveyors, S/S Elevator, S/S Hood.
- 1—5' x 12" Buflovak Atmospheric.
- 2—32" x 90" Buflovak Atmospheric.
- 1—32" x 72" Buflovak Atmospheric.

#### PEBBLE MILLS

All porcelain lined

- 1—Abbe 5' x 6', 10 H.P. motor.
- 3—5' x 4', 235 gal.
- 2—6' x 6', 800 gal., porcelain and burrstone lined.
- 1—Abbe #4 porcelain lined, 125 gal., 45" x 42", 5 H.P. motor.
- 1—Patterson 24 x 36", 25 gal.

#### VIBRATING SCREENS

- 1—Tyler Hammer 4"x10", 2 deck, with 2 vibrators and generator set.
- 1—Battery of two 3"x3" Tyler Hammer, Type 33, with Generator Set for both.
- 1—3"x8" Selectro, single deck.
- 1—3"x8" Selectro, double deck—rebuilt.
- 1—18"x3" Selectro—rebuilt.
- 2—Day Ro Ball Size 82, dbl. deck, 40"x120".
- 1—Rotex, sgl. deck, 20"x48".

#### PULVERIZERS

- 1—Raymond 5-roll, high side.
- 3—Mikro Pulverizers, 251, 41TH.
- 1—6"x15" Sturtevant Jaw Crusher, to 1/2".
- 1—24"x15" Sturtevant Crushing Rolls, Spherical type.

#### MISCELLANEOUS

- 1—45" Stainless Steel A.T.M.C. Centrifugal, 40 H.P. Motor.
- 3—Anco 4"x8" Chilling Rolls.
- 1—Pneumatic Scale packaging line.
- 2—Buflovak 6' dia. Vacuum Crystallizers;
- 1—6" dia. Atmospheric, jacketed.
- 1—6"x14" Hardinge Rotary Counter Current Classifier, also for dewatering or scrubbing.
- 2—Dorr two-stage classifiers, each with two rakes, total length 27', gear reducer and motor.
- 1—Davenport #2A Dewaterer, with speed reducer and 3 HP AC motor.
- 1—Mechanical Cooker, 5' dia. x 18 long, jacketed, agitated, Insur. Certificates.
- 1—20 gal. jacketed, dbl. sigma bladed Baker Perkins Mixer, m.d.
- 1—Patterson, 110 gal. S. S. Vacuum Mixer, dbl. sigma blades, 75 H. P. Motor.

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Triangle Elec-Tri-Pak G2C, A6CA Fillers.

Filler 4-Head and Hope 6-Head Stainless Steel Piston Fillers.

2000 gal., 500 gal. Jacketed Mixing Tanks.

Horix S. S. 14-Head Rotary Filler.

Standard Knapp No. 429 Carton Sealer.

Mikro 4TH, 3TH, 2TH, 1SH and Bantam Pulverizers; Schutz-O'Neil Mills.

Tri-Homo #5 Colloid Mill, 7½ HP.

3500 gal. working cap. Steam Jacketed, Double Arm Mixing Tanks for mixing, storing or processing of your materials.

Day 650 gal. Steam Jacketed Mixer.

B. P. 150 gal. Unidur S. J. D. A. Mixer.

Stokes, Day, New Era, Hottman Mixers, from 2 to 450 gal., with and without Jackets, Single, Double Arm Agitators.

Baker Perkins and Readco Heavy Duty 6 to 150 gals. Double Arm Jacketed Mixers with Sigma or Fish Tail Blades.

J. H. Day 8 gal. Pony Mixer.

Day 100, 800, 1500, 10,000 lbs. Dry Powder Mixers and Sifters.

Lee 85 gal. S. S. Jacketed Mixing Kettle.

Pony M, ML Labelers; World and Ermold Rotary and Straightway Labelers.

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Pneumatic Scale Cartoning Line, 60 and 30 per minute.

Oliver cellophane adjustable Wrapper. Miller, Scandia, Hayssen, Wrappers.

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Crushers: Roll, Allis Chalmers 36x18", 24x14".  
Crusher: Jaw, Universal 6"x36".  
Screens: 2—Tyler-Hummer 4"x10".  
Screen: 1—Bolex 40"x84".  
Elevators, Blowers, Trough Conveyors, Motors, Steel Bins and Miscellaneous Items.

- 1—30" Tolhurst imperforate basket suspended Centrifugal.
- 1—250 gal. working capacity Heedco stainless steel, double arm sigma blade Mixer with 50 hp. M.D.
- 1—12 x 24" Farrell-Birmingham 2-roll Rubber Mill with 25 hp. drive.
- 5—3000 gal. Plowdrill jacketed glass lined (dairy) vertical Tanks.
- 50—Stainless steel Tanks (New and Used) up to 1000 gallons.
- 30—S.S. steam jacketed Kettles (new and used) up to 150 gallons.
- 1—20 gal. Stokes S.S. Vacuum Pan.
- 1—Day 3000 lb. jacketed Powder Mixer.
- 12—Filter Presses — recessed and plate and frame—from 7" to 30".
- 5—Day 12 x 32" 3-roll Mills.
- 3—Double drum Atmospheric Dryers — 42 x 120", 32 x 96", 24x60".
- 5—8" x 40" Rotary Hot Air Dryers.
- 8—Dry Powder Mixers — 100 to 3000 lb. cap.
- 1—New Premier 3" stainless steel Colloid Mill with 7½ hp. motor.

- 1—Charlotte M-15 stainless steel Colloid Mill with 15 hp. motor.
- 3—Clarifiers — Sharples airlight, stain. steel, 2 hp.
- 2—Steel Tanks—2000 gal. heavy duty steam jacketed, open top.
- 2—De Laval 54-81 motor driven Clarifiers.
- 8—Agitators: Neito WT-27, stain. steel turbine type.
- 1—Disintegrator: Rietz-40 hp.
- 1—Evaporator: New stain. steel, 3000 lb. per hr. evaporation.
- 1—Vacuum Pan: 26" Monnier stain. steel.
- 1—Oliver Filter 3' x 4', Everdur construction.
- 1—Davenport Rotary Press, #3A, Durimet #20 screen plates.
- 1—Dry Roball Screen 40" x 84", single deck.
- 1—Ball & Jewel #2 ball bearing Rotary Cutter.
- 1—Nash Hytor Pump H3, 20 hp.

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**CLASSIFIERS:** 4—Akins and Wemco 54" x 23 ft. simplex, single screw, high weir, with syncogear motor, 220/440 volt, with lifting device. Condition like new, available now. Located Nevada.

**FLOTATION EQUIPMENT:** 7 banks, 9 cells each, 45 cubic ft. units complete with blowers, agitators, etc. Used only 6 months, condition like new.

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**LOCOMOTIVE CRANE:** Link Belt 25 ton capacity, standard R.R. gauge, gasoline powered, cast steel trucks, air brakes, with or without 1 1/4 yd. Williams clam shell bucket, thoroughly modern, excellent condition. Located Minnesota.

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1—Eppenbach Stainless Steel Home Mixer, complete with a 7½ HP Explosion-Proof Motor.

1—Perry 100 Gal. Stainless Steel Mixer, double-arm sigma blades, with 20 hp explosion-proof motor.

1—J. H. Day 22, 75 Gal. Brighten Mixer.

10—Pebble Mills 40 to 800 Gal.

10—Pony Mixers, 8, 15 and 40 Gal.

HIGH SPEED Roller Mills 9"x24" to 16"x48".

1—Motor Driven Belt Conveyor.

1—Standard Colloid Mill, water cooled.

2—250 Micro-Pulverizers with 10 hp Motors.

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- 1—Feine Stainless Steel Rotary Vacuum Filter, 5' x 3'.
- 2—Oliver Rotary Vacuum Filters, 5'3" x 6', Steel Construction with Monel Screens.
- 1—Vulcan Rotary Kiln, 7' x 120'.
- 1—Bird 24" Monel Screen Type Centrifugal Filter.
- 1—Oliver Homogenous Lead Filter, 8' x 8'.
- 1—Sperry Aluminum Plate & Frame Filter Press, 42" x 42", Closed Delivery, 3" Frames, 35 Chambers.

**DRYERS—KILNS**

- 1—Bullovak Stainless Steel Lab. Double Drum Dryer, 6"x6".
- 1—Buggles Cole Rotary Dryer, 7½"x80".
- 4—Devine, Stiles & Bullovak Vacuum Shelf Dryers, 5', 9', & 12' Shelves.
- 2—Bullovak Double Drum Dryers, 32"x80" & 42"x120".
- 1—Louisville Rotary Steam Tube Dryer, 6"x50".
- 1—Hunn Rotary Steam Tube Dryer, 3'x12'.
- 2—Bullovak Vacuum Drum Dryers, 24"x20".
- 1—J. P. Devine Rotary Vacuum Dryer, 5'x25'.
- 2—Bullovak Double Door Vacuum Shelf Dryers, 20 shelves each.

**FILTERS**

- 4—Sperry Stainless Steel Filter Presses, 12" x 12", Closed Delivery, 10 Chambers.
- 1—Shrivers Stainless Steel Filter Press, 24" x 24", Closed Delivery, 10 Chambers.
- 3—Shrivers 24"x24" Aluminum Plate & Frame Filter Presses, Closed Delivery, 35 Chambers each.
- 1—Sperry 42"x42" Cast Iron Plate & Frame Filter Press, 16 Chambers, Closed Delivery.
- 1—Sperry 12" Bronze Plate & Frame Filter Press, Closed Delivery, 8 Chambers.
- 1—Shrivers 42"x42" Evedur (Bronze) Plate & Frame Filter Press, 40 Chambers, Closed Delivery.
- 1—Shrivers 36"x36" Cast Iron Plate & Frame Filter Presses, Closed Delivery, 24 & 25 Chambers.
- 5—Swedeland Filters, #2, 5, 7 and 12.
- 1—Oliver Rotary Steel Filter 3"x1".
- 2—Shrivers 24"x24" cast iron, closed delivery, filter presses, 3 eye, 25 chambers.

**CENTRIFUGALS**

- 1—Fletcher Stainless Steel Suspended Type Centrifuge, 40" Perforated Basket.
- 2—A. T. & M. Stainless Steel Suspended Type Centrifuges, 48" Imperforated Basket with motors.
- 1—A. T. & M. Stainless Steel Suspended Type Centrifuge, 54" Imperforated Basket with motors.
- 2—Fletcher 40" Whirlwind Centrifuges, Bronze Perforated Basket with Explosion Proof Motors.
- 1—Tolhurst Stainless Steel Suspended Type Centrifuge, 40" Imperforated Basket.
- 1—Fletcher 48" Whirlwind Centrifuge, Bronze Perforated Basket with Explosion Proof Motor.
- 1—Tolhurst Center Slung Centrifuge, 36" Perforated Steel Basket with Explosion Proof Motor.
- 1—Tolhurst Center Slung Centrifuge, 36" Perforated Steel Basket with Explosion Proof Motor.
- 1—Sharples Stainless Steel Super D Centrifuge, Model FN-14.
- 8—Sharples #16-Y Stainless Steel Super Clarifying Centrifuges.

**MIXERS**

- 3—Baker Perkins Steel Jacketed Mixers, 200 gal. Working Cap., Sigma Blades.
- 1—Lightnin' Mixer, Model SAG 1000, 10 HP Explosion Proof Motor.
- 1—Netco Drive, Model WT 27, output speed 16.
- 1—Scrubby Mixer #1.
- 1—Simpson #1 Intensive Mixer.
- 4—Baker Perkins Steel Jacketed Mixers, Sigma Blades, 100 Gals.
- 3—Baker Perkins Stainless Steel Jacketed Mixers, Sigma Blades, 100 Gals.
- 1—J. H. Day Jacketed Powder Mixer, 5000 lbs. Center Discharge.
- 3—Turbo Steel Jack Mixers, 700 Gals. Each.
- 12—Simpson #2 Intensive Mixers "Unused".
- 1—Readco Stainless Steel Jacketed Double Arm Jacketed Mixer, Sigma Blades, 225 Gals.
- 1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 gals. working cap., 150 gals. total cap., 75 HP Drive.

**PULVERIZERS—GRINDERS—MILLS**

- 1—Mikro #3TH Mikro Pulverizer with 30 HP Motor.
- 1—Mikro #2W Pulverizer.
- 1—Mikro #2TH Pulverizer, Stainless Steel & Bronze Construction, with Motor.
- 1—Abbe #2 Master Rotary Cutter.
- 1—Ball & Jewell #20 S.S. Rotary Cutter.
- 2—Ball & Jewell #2 Rotary Cutters.
- 1—Blow Knob Air Mill Pulverizer.
- 1—Mikro Stainless Steel Atomizer #8.
- 3—Thropp 2-Roll Rubber Mills, 15"x50".
- 1—Abbe #2 Buhrsone lined Pebble Mill, 5"x4".
- 1—Gruendler #24-40 Hammer Mill.
- 1—Thropp 2-Roll Rubber Mill, 10"x24".

**MILLS**

- 1—Sprout Waldron #38 Attrition Mill with 2-75 HP Motors.

**AUTOCLAVES—KETTLES—TANKS**

- 1—Adamson Steel Vulcanizer 6"x20".
- 2—Blow Knob Steel Jacketed Autoclaves, 300 & 500 Gals. Cap., Working Pressure 500 Lbs.
- 1—Glassco glass lined jack. vac. reactor, 1600 gals. cap. (Unused).
- 1—Patterson Steel Jacketed Autoclave, 900 Gals. Cap., Internal Pressure 120 Lbs.
- 1—Stainless Steel High Pressure Autoclave, 10 Gals. Cap., 250 Lbs. Internal Pressure.
- 1—Pfaudler Glass Lined Jacketed Vacuum Reactor, 500 Gals. Cap.
- 1—Pfaudler Glass Lined Jacketed Kettle with Anchor Type Agitator, 150 Gals.
- 12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap.
- 1—Koven 5, 5, Storage Tank, 1200 Gals. Cap.
- 1—Koven Steel Mixing Tank, 1200 Gals. Cap. with Netco Drive, 10 HP Explosion Proof Motor, Turbin Agitator.



THE GELB GIRL—APRIL 1953

- 1—Combustion Engineers Stainless Steel Jacketed Autoclave, 500 gal. cap., 300 PSI internal pressure.
- 1—Stewart Boiling 2-Roll Experimental Mill, 6" x 12".
- 1—Patterson Stainless Steel Autoclave with Turbine Agitator & Explosion Proof Drive, 200 gal., 225 PSI.
- 1—J. H. Day Stainless Steel Jacketed Double Arm Mixer, Sigma Blades, 12 gals.
- 3—Downington Stainless Steel Heat Exchangers, 45 & 500 sq. ft.
- 1—Struthers Wells Hastelloy B Heat Exchanger, 450 sq. ft. Unused.

- 1—Artesian Steel Jacketed Kettle, 1,000 Gals. Cap., with Rake Type Agitator, ASME Code, 50 Lbs. Pressure.
- 2—J. P. Devine Jacketed Vacuum Reactors, 2,000 Gals. Cap. Each.
- 2—Buffalo Steel Pressure Tanks, 1,000 & 10,000 Gals. Cap., 100 & 125 PSI ASME Coded.
- 2—Steel Storage Tanks, 8,000-17,500 Gals. Cap.
- 1—Steel Rubber Lined Storage Tank, 4,500 Gals. Cap.

**MISCELLANEOUS**

- 1—Bullovak Type VRG Double Effect Monel Evaporator, 250 sq. ft.
- 1—Alco Stainless Steel Heat Exchanger, 60 sq. ft.
- 1—Ambaco Model SA Heavy Duty Horizontal Continuous Eater.
- 3—Vulcan all Copper Condensers, 300 & 350 sq. ft.
- 1—Day on Dowd Centrifugal Pump, Stainless Steel, Size IC8, 35 GPM at 40' head, speed 1745 RPM, 2"x1".
- 1—Worthington Worblow Pump, with 7½ HP Motor.
- 2—Worthington Antaciron Centrifugal Pumps, Model #3 CUI, 4"x3".

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# CHEMICAL EQUIPMENT

## CENTRIFUGES

24" Bird, type CH, SS.  
40" Fletcher, type 304 SS.  
40" Tolhurst, perforated.

## DRYERS—MISC

30'x8' Stokes, Model 59AB, vacuum, rotary.  
5'x6' Blow-Knox, Drum, atmospheric.  
24"x28' Proctor & Schwartz Conveyor.  
Raymond Flash Dryer, complete.  
6'x33' Louisville Steam Tube.

## DUST COLLECTORS

4,488 sq. ft. Sly type 360.  
2,244 sq. ft. Sly type 360.  
3,900 CFM, Dracco, SS.

## EVAPORATORS

148 sq. ft. Buflovak, double effect, Monel.

## FILTERS

8'x12' Feinc, rotary, vacuum.  
8'x10' & 11'x18', Oliver.  
No. 7 Sweetland, 172 sq. ft., 41 tops.  
36" Shriver, C.I., 36 chambers.  
12" Sperry, C.I., aluminum, 10 chambers.  
3'x3', Monel, Feinc, complete (2).

## HEAT EXCHANGERS

5740 sq. ft. Vegt, chrome-moly tubes.  
1024 sq. ft. 8 pass, steel tubes & shell.  
400 sq. ft., 2 pass, Admiralty tubes (NEW).

## KILNS—COOLERS—DRYERS

7'x160'x56" (2).  
7'x120'x56".  
7'x60'x56".  
5'x25'x9'16" Allis Chalmers.  
5'x30'x56" Ruggles Cole.  
4'x60'x12".  
4'6"x40'x56" Traylor.  
3'x24' Monel.

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12-10,000 & 20,000 Gal. 5'11" Horiz.  
14-8,000 & 10,000 Gal. R.R. Car Tanks.  
6-1,000, 5,000 & 10,000 Bbl. Vert.  
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## FOR SALE

250 gal. S.S. Tank, 42"x42", agit.  
8'x12' Feinc, rotary, vacuum.  
100 to 200 gal. S.S. Mix. Tanks, water jkt.  
2000 gal. S.S. Truck Tanks, trailerized.  
75 gal. Monel Jkt. Kettle, 30"x27", agit.  
100 gal. S.S. Clad Jkt. Kettle, 30"x25".  
150 gal. S.S. Jkt. Kettle, 42"x34", agit.  
4-50 gal. Steel Kettles, 75"x Jkt. A.S.M.E.  
75' Centrifugal Extractor copper baskets.  
Quincy Vacuum Pump, 11 C.F.M., 1/2 H.P.,  
Model 140C Stokes High Vacuum Pump, 1/2 H.P.,  
2" S.S. Centrifugal Pump, 2 H.P.  
Hobart Grinder, 1/2 H.P.  
Roots Compressor Blower, 2 H.P.  
300 ton Heavy Suspension Tank Scale.  
32"x30' & 36"x34' Double Drum Dryers.  
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## MILL

Raymond 5 roll, high side, complete.

## PUMPS

100 GPM @ 25' head, Monel (4).

## REACTORS—Acid Glass

400 gal. Pfaucler, ASME.  
500 gal. Pfaucler, ASME.  
2,000 gal. Pfaucler, type XXL, ASME (2).  
2,000 gal. Pfaucler, type RL, ASME.

## REACTOR—Stain. Steel Clad

3,000 gal. Jackt'd, ASME (NEW).

## SCALES

Sacking Scale with Dustite Bag Holder (2).

## SCREENS

3'x8' two deck, Kennedy.

3'x8' single deck, Kennedy.

## STORAGE TANKS

3,400 gal. 7'4"x10'x36" type 430 SS.  
4,100 gal. 5'x28'x34".  
6,000 gal. 8'x15'x36" vert. ALUMINUM.  
6,500 gal. TANK CAR TANKS, 76"x28".  
8,300 gal. 8'x23'x5'16" vert. (NEW).  
12,000 gal. 8'x32'x14" (NEW).  
15,000 gal. 10'6"x23'x14" (NEW).  
135,000 gal. 30'x26' w/cells.

(We have facilities for building of new tanks. Send us your inquiries.)

## PRESSURE VESSELS

1,050 gal. 4'x12'x1/2" 106 PSI.  
1,200 gal. 42"x16'x5'16" ASME 125 PSI.  
1,250 gal. 4'x14' 106 PSI.  
8,200 gal. 8'x23'x22' 390 PSI (4).  
16,000 gal. 9'6"x45'x3/4" ASME 150 PSI.  
30,000 gal. 10'x47' ASME 50 PSI.

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# Stainless Steel Equipment Center

We have many Standard pieces of Equipment with Stainless Steel Contact parts. We fabricate Stainless Steel Tanks and Coded Pressure Vessels; Stainless Spiral Mixers; Portable Agitators, etc. Send us your inquiries.

## Partial Listings

- 2-Bird 48" S.S. Sus. Style Centrifuges DMD.
- 1-Tolhurst 48" S.S. Center Slung Cent. MD.
- 1-Bird 12" Steel Sus. Centrifuge XP Motor.
- 1-Devin 13 Shelf Vac. Dryer 40" x 43".
- 1-Buflovak 32" x 90" Double Drum Dryer.
- 1-Stokes 6 Shelf Vac. Dryer 24" x 36".
- 1-Buflovak 6' Jack. Vac. Crystallizer.
- 1-Sweetland Filter #22-72 leaves.
- 5-Wood P. & F. Filters 18"-24"-42".
- 1-Sperry C.I. 24" Filter Press Hyd. Closure.
- 2-Sperry 36" C.I. Filter Presses Hyd. Closures.
- 8-Stainless Jack. Kettles 100 to 950 Gals. Ag.
- 3-Dopp Jack. Kettles 60, 250 & 600 Gals.
- 5-Mikro Pulverizers Lab. to 2th & 2FF Stainless.
- 1-Rotex Screen 40" x 120" Motor Drive.
- 3-Bubble Cap Columns 27" & 36" Alum.
- 2-Erie City 200HP Boilers 150#WP (1947).
- 5-Stainless Steel Tanks—240 to 5700 Gals.
- 3-Horiz. Steel Tanks 7500 to 20,000 Gals.

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2-Single acting plunger type vert. triplex power pumps, size 1-1/4" x 8" 42.6 GPM, discharge pressure 501A 2900#, motor driven, new 1944, price on request.

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10 TO 5000 HP... 10 TO 900 PSI  
**DIESEL ENGINES — STEAM TURBINE GENERATORS**  
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JAW CRUSHERS—7" x 12" up to 36" x 48"  
CRUSHING ROLLS—10" x 10" up to 34" x 34".  
GYRATORY CRUSHERS—23 up to 31". Also one  
14", 16", & 42" Superior McCully gyratory crusher.  
SWING HAMMER MILLS  
ROTARY FLUID CRUSHERS—\$1, #11 and #22.  
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Semi-Indirect Heat ROTARY DRYERS—7"  
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RAYMOND MILLS—20, 26, 30, #11.  
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TUBE ROD & BALL MILLS—4" up to 8" dia.  
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- 1—Vulcan 7'x160',  $\frac{3}{8}$ " shell, two 12" tires complete.
- 1—Vulcan 7'x120',  $\frac{5}{8}$ " shell, two 12" tires complete.
- 1—Ames 6'x60',  $\frac{1}{2}$ " shell, two 8" tires.
- 1—5'6"x25',  $\frac{1}{2}$ " shell, two 6" tires.
- 1—Kennedy Van Saun 4'x60',  $\frac{1}{2}$ " shell, two 12" tires, complete.
- 4—Rotary Dryers 7'x60', 5'x67', 4'6"x40', 3'x25'.
- 2—Hersey 6'x23', 5'x23' Hot Air Rotary Dryers.
- 4—Louisville Steam Tube Dryers 6'x50', 6'x30', 5'x28', 3'x20'.
- 1—Devine double door vacuum shelf Dryer, having 17-159"x78" shelves.
- 4—Devine single door vacuum shelf Dryers, having 20, 10, 6 and 4-40"x43" shelves.
- 5—Stokes & Buflovak Rotary Vacuum Dryers 30"x8", 3"x15", 6'6"x38".
- 5—Buflovak 60"x144", 42"x120", 32"x90" Atmospheric Double Drum.
- 1—Single Drum 60"x80" Flaker.
- 1—14 Truck steam heated Dryer 1680 sq. ft.
- 3—Buflovak 6' diameter, Vacuum and Atmospheric Crystallizers.

### FILTERS

- 2—Oliver Monel 8'x10' Rotary-Vacs.
- 1—Oliver SS 8'x10' Rotary-Vac.
- 2—Feinc Monel 5'x3' Rotary-Vacs.
- 3—Oliver 5'3"x3", 3'x1' Rotary Vacuum Enclosed Precoat.
- 8—Oliver Rotary Vacuum 11'6"x18', 11'6" x14', 8'x12', 8'x10', 8'x8', 8'x6', 3'x1'.
- 2—Eimco Steel 8'x12' Rotary-Vac.
- 1—Feinc steel 8'x12' Rotary-Vac.
- 2—Sweetland #12 with 72 and 36 leaves.
- 1—Sweetland #10 with 18 leaves.
- 1—Sweetland #7 with 27 leaves.
- 3—Vallex 500 sq. ft. Rotary Pressure.
- 1—Sperry 36" Recessed, 48 chambers, c.i., open delivery.
- 5—Shriver 30" P&F, 30 chambers, c.i., open delivery.
- 8—Sperry 24" P&F, 16 chambers, c.i., closed delivery.
- 1—Shriver 24" Recessed, 30 chambers, c.i., open delivery.
- 3—Shriver 18" Recessed, 30 chambers, c.i., open delivery.
- 2—Sperry Aluminum 30" and 24" P&F, 22 and 26 chambers.
- 10—Shriver Sperry Filter Press Skeletons 42" to 18".

### CENTRIFUGALS

- 1—Fletcher 48" Suspended Aluminum bottom discharge, perforated basket, motor driven.
- 2—NEW Tolhurst 40" Suspended, 316 SS, bottom discharge, perforated.

- 1—Fletcher 40" Suspended, SS, bottom discharge, perforated basket.
- 1—Tolhurst 32" Suspended Monel, bottom discharge, perforated.
- 1—Fletcher 30" Suspended Steel, bottom discharge, perforated.
- 1—Tolhurst 30" Suspended Rubber, bottom discharge, perforated.
- 1—Tolhurst 26" Suspended, steel, bottom discharge, perforated.
- 2—Bird 36"x50" solid bowl, rubber and stainless.
- 4—Bird 36"x72", 36"x50", 24"x38", 18"x 28" solid bowl continuous, steel.
- 2—Sharples #16P Monel Super Centrifuge.

### PULVERIZERS

- 2—Raymond 4 roll High Side Mills, comp.
- 1—Hardinge 4 $\frac{1}{2}$ x16" Conical steel-lined Ball Mill, 30 HP motor.
- 1—Bauer 36" Attrition Mill 2-50 HP mtrs.
- 8—Patterson 6'x8', 5'x6', 4'x5', 4'x4 $\frac{1}{2}$ ' Pebble Mills.
- 5—Abbe 3'x4', 3'x3 $\frac{1}{2}$ ' Pebble Mills.
- 2—Premier Colloid Mills 8" dia., SS.
- 1—Eppenbach QV7 Colloid Mill.
- 2—Jeffrey 36"x24", 20"x12" Hammer Mills.
- 3—Raymond, Gayco Mechanical Separators 14', 12', 4'.
- 1—Two Roll Rubber Mill 6"x12".
- 2—Mikro No. 151, No. 15H Pulverizers.
- 1—Fitzpatrick Commuting Mill, 5 HP.
- 2—Sturtevant 5"x8" Roll Crushers.

### SCREENS

- 1—Selectro SS double deck 4'x10'.
- 5—Sprout Waldron SS, single deck, 40"x 84".
- 1—Day Ro-Ball single deck 40"x120".
- 4—Rotox #42, #22, and #11 single and double deck Screens.
- 1—Robinson double deck 20"x50".
- 5—Tyler Hummer 3'x5' triple deck.
- 6—Tyler Hummer 3'x15', 3'x10', 3'x5' single deck.
- 1—Abbe #2 Blatberg Sifter.
- 1—Selectro Double Deck 18"x48".

### MIXERS—ALL TYPES

- 4—Baker Perkins 200, 100 and 50 gallon, jacketed, double arm, sigma blades.
- 1—Baker Perkins 300 gal. Unidor SS.
- 1—Baker Perkins 35 gal. SS jacketed, double arm.
- 1—NEW Struthers-Wells 347 SS, 12 gal. double arm, jacketed vacuum.
- 1—Patterson 5' dia. Conical steel.
- 1—Baker Perkins  $\frac{1}{2}$  gal., jacketed.
- 1—Baker Perkins, type JNM, 100 gal., jacketed, double arm.
- 1—Day 30 gal. Imperial jack, double arm.
- 10—Rodgers 200 to 3000# Powder Mixers.
- 1—Robinson 4000# steel Powder Mixer.
- 12—Electric, Port. Agitators  $\frac{1}{4}$  to 5 HP, NEW.
- 4—Day, Ross, 8 and 50 gal. Pony Mixers.

### MISCELLANEOUS

- 20—Bucket Elevators, steel housing, 34' to 90' centers, 8"x5" to 24"x8" buckets.
- 1—Lummus 4' dia. copper bubble cap Column.
- 7—Stokes Vacuum Pumps 15 to 100 CFM.
- 5—Devine, Buflovak, Condensers and Receivers, 20 to 90 sq. ft.
- 1—Newman 2500# Soap Crutcher.
- 4—Groen 150, 125 gal., SS, jacketed, agitated Kettles.
- 4—Stokes DD2, D4 Rotary Tablet Machines.
- 4—38" dia. SS Revolving Pans.
- 2—Nash #4, AL671 Vacuum Pumps.
- 7—Olivite, Duriron, rubber, Karbate and Havey Centrifugal Pumps 6" to 2".



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- 1—Devine #12 Van. Sheet Dryer, 40" x 42" shelves.
- 2—Ruggies Coles 7 1/2" x 60' & 6' x 45' Rotary Dryers.
- 1—Ruggies Coles 60" x 20' Rotary Indirect Heat Dryer.
- 1—Christie 60" x 60" Rotary Indirect Heat Dryer.
- 2—6 fan automatic Conveyor Dryers.
- 1—Albright-Nell 4' x 9' Atmes. Drum Dryers.
- 1—Baldwin Van. Drum Dryer 24" x 24".
- 1—Gardner Gas Filter Dryer 12" x 32".
- 6—Steam, Gas & Electric Dryers, Tray & Truck.
- New Tray & Truck Atmes. Dryers, good deliveries.

## CENTRIFUGALS &amp; CENTRIFUGES

- 8—Tolhurst 40" Suspended Type Centrifugals, Bot. Disc. Discharge, Motor Driven.
- 4—Centrifugals 30", 35", 40", 42", 44", 46", 48", Steel, Copper, Stainless & Plastic Lined.
- 12—Sharples Centrifuges, 25A Stainless. Also 28.
- 3—DeLaval Multiple Clarifiers #209, 300 & 301.

## FILTERS

- 1—Valley 41 Stainless Covered Leaf Filter, type 49.
- 10—Spiral & Sphere 12", 16", 24", 30", 36", Iron.
- Sweetland & Oliver Rotary Vac. Filters.

## KETTLES &amp; TANKS

- 1—Deep 350 gal. Cl. Agit. Jack. Van. Kettle.
- Devine 50" dia. Impreg. Used stainless Jack-Liqueur & Impreg. Kettles.
- 1—1000 gal. closed jack agit. steel kettle.
- 1—2300 gal. vert. agit. Jack Steel Kettle.
- 8—Jacketed Kettles 50 to 2500 gal.
- 1—250 gal. Lead Lined Kettle.
- 2—Pfandier 500 gal. vert. Glass Lined Tanks.
- New Stainless Steel Tanks 10 to 3000 gal.
- 50—Stainless Alum., Copper, Glass, Lead Lined Kettles & Tanks. Also new Stainless.
- 6—Copper Varnish Kettles 150, 200 & 300 galas.

## PULVERIZERS &amp; MILLS

- #1 Raymond Automatic Pulverizer 20 H.P. motor.
- 1—Raymond #100 Pulverizer 30 H.P. Complete.
- 1—Spiral Raymond Mill.
- 1—Hammer Mills & Pulverizers 3 to 50 H.P.
- 1—Schultz-O'Neill 20' Pulverizer. Also F.I.
- 1—Sturtevant 30' Rock Emery Mill.

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Diesel Fuel and Lube Oils, Stainless Steel and Monel Bowls, Capacities 100/150 GPH when handling oils having a viscosity of 45 to 205 S.S.U. at 100 to 250° F. AC or DC Motors.

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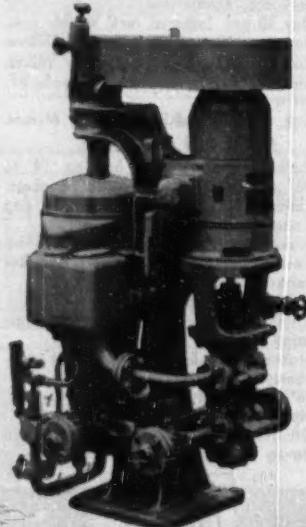
Lube Oil Models 55N-23 & 55N-13, Stainless Steel Bowls, Capacities 150/250 GPH when handling oil having a viscosity of 205 S.S.U. at a temperature of 130° F., complete with Pumps and powered by 2 HP DC Motors.

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Davenport Rotary Press, #3A, 40" Tolhurst imperforate basket, type 316 S/S suspended centrifugal.

30HP Clayton Steam Generator.

DeLaval Centrifugal Still—Complete.

Alpha 1000 Gallon Dryer—36" x 100"—6" dia. trim Fitzpatrick Mill included—Complete.

Grupe Dryer—6" dia. 26' long, 44" tubes, complete.

Stokes Vacuum Pump—100 cfm—complete with motor.

Lightnin' D-2 and D-2A, slow speed, portable dryers.

30 x 36 P. & F. Filter Press—32 plates—33 frames open daily.

in stock at all times: NEW AND USED KETTLES

—1000 gal. S/S and plain steel.

Robinson Gardner type Mixer—Model "J" 42.5 Cu. Ft. capacity.

2—3000x DOUBLE RIBBON MIXERS—Jacketed

—1800x W.P. Mixer.

2—Baker Perkins—Double Sigma Arm—Jacketed

Mixer—150 gal. Cap. Portable Agitators with new motors.

ADDITIONAL: 12x18x16 IN STOCK—Ribbons &

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3000 gal. S/S Horizontal Tanks—Insulated—Com-

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900 gal. Tank—8" S—58" x 56" deep.

NEW—1 HP side entering Agit. W/motors and cover.

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70" x 33" Ruggies Coles A-10.

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Kilns: 4" x 60", 5" x 60", 7" x 60", 8" x 60".

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Hammer Mills: Jeffrey 36x24B, Williams 230,

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Dings 60"—3 Roll Type IR Magnetic Separator.

12" x 10' Dorco Drum Filter.

40" x 30" Dorco 3 Tray, 4 Compartment Thickener.

6x6, 6x10, 7x8 & 8x10 Ball Mills.

2—Raymond Automatic Pulverizer.

2—Baldwin 3000 Dust Filters, each 19000 Sq. Ft.

150' x 6' Multiclene Dust Collector.

10' x 48" Hardinge Air Classifying Rod Mill.

4" x 7' Peripheral Discharge Rod Mill.

Heavy Media Separation Unit.

Hercules Junior 3 Roll Pulverizer.

Clyde-Kuntz Compressor Hydrator.

Electric Air Compressors 1300, 3100 & 3374 Ft.

120,000 & 16,000 Gal. Tank Cars.

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E—Evaporators Steel, 350 and 3500 gal.

Q—Quimby Pump 1 1/2" Double Sided.

U—Scrubber, Island 22" x 6" Long.

I—Intensive Simpson Mixer Size "O" Style M.

P—Pulverizers Mikro #1—2—3 & 4.

M—Mills Patterson Jkt'd 6" x 16" & 4 1/2" x 5"

E—Ejector, Two Stage 8" type B 33.

N—Nash Hydr Pump Model L 6

T—Tablet Machine, Stokes RD 4 Complete

C—Cutters Rotary Able #1—3 & 2 1/2

L—Louisville Rotary Dryer 6" x 50"

E—Elmo 8" x 12" Vacuum Filter Complete

A—Autoclave 3500 Gal. Capacity & 1000 psi.

R—Reactor, type 247 55 30 gal. Cap.

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N—New Steel & SS Ribbon Mixers

G—Groen 88 Jacketed Kettles, all sizes

H—Horizontal 10,000 gal. Steel Tanks Welded

O—Orville Simpson 20" x 48" Sifters

U—United Oliver Filter 8" x 12" & 3" x 12"

S—Sparkler Filters Model 33-D-17 & 14-S-5

E—Evaporating Dish, Glass & Nickel Clad

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- 2 Aluminum Bubble Cap Columns, 36" dia. x 45 plate.
- 1 Aluminum Bubble Cap Column, 27" dia. x 18 plate.
- 1 Aluminum Perforated Plate Column, 28" dia. x 36" plate.
- 2 Copper Bubble Cap Columns 6" dia.
- 1 Copper Beer Still Column 6" dia.
- 1 Copper Column with 18—30" dia. perforated plates and 10—24" dia. bubble cap plates.
- 1 Steel and Cast Iron Bubble Cap Column, 30" dia. x 62 plate.

## CONDENSERS—EXCHANGERS

- 3 Aluminum tub. 166 sq. ft.
- 15 Alum. Coll Exch. 47 sq. ft.
- 7 Copper tub. 20, 65, 90, 140, 1350 sq. ft.
- 4 S.S. tub. 8½, 190, 330 & 400 sq. ft.
- 3 S.S. Coil Condensers, 40 sq. ft., 60# pr.

## DRYERS—EVAPORATORS

- 1 Stokes #58A Jacketed Vacuum Rotary Dryer, 18" dia. x 42" long.
- 2 Atm. Double Drum Dryers, 22" x 38".
- 1 Cummer Rotary Hot Air Dryer, 46" dia. x 26' long.

## FILTERS

- 1 Sweetland #10, 21 Ivs.
- 1 Sweetland #12, 72 Ivs.
- 1 Swenson Rotary Continuous Vacuum Filter; Precoat type, 8" dia. x 8' face, rubber covered and lead acid proof construction.
- 1 FEINC Rotary Vacuum Filter, string discharge, 4½" dia. x 6' face, aluminum.
- 4 Pressure Leaf Filters, 70 to 90 sq. ft.
- 2 Shriver 36" Filter Presses, rubber covered, closed doily, washing, hydr. closing.
- 1 Louisville 8-roll Continuous Filter or Grains Press 24".

## NOW LIQUIDATING

Equipment of Patrick Henry Brewery, Marion, Indiana:  
 32—Horiz. Welded Steel Tanks, dished heads: 10,500, 11,300 and 12,700 gal.  
 6—5500 gal. Vertical Closed Welded Steel Tanks, dished heads.  
 22—8300 gal. Welded Steel Rectang. open top tanks—16'10" L x 7'7" W x 8'6" H.  
 1—4000 gal. Vertical Steel Cooker, Jkt'd. Agit.  
 1—Dracco Pneumatic Grain Conveying System.  
 1—Sperry 24" C.I. Filter Press, 16 Ch.  
 1—Ammonia Compressor with motor: 10 x 10 (82 ton).  
 1—Steel Shell & Tube Condenser: 1000 sq. ft.  
 Lot of miscellaneous equipment—pumps, coolers, scales, kettles, tanks, bottling machinery, etc.

## JUST PURCHASED

- 1—Buffevak Atm. Double Drum Dryer, 24" x 36".
- 2—Tyler Hammer Screens, 3-deck, 4" x 3'.
- 15—Jeffrey Vibrating Feeders #1B.
- 1—Stainless Steel Pressure Vessel, 600# WP—T304, 18" dia. x 9'4".
- 140—Stainless Steel Flanged Gate Valves, 1", 1½", 2" & 3".
- 6000 ft. Stainless Steel Tubing, T304, 16 ga., 1½" & 2" OD, 6'3" lengths.
- 1—1250 gal. Stainless Steel Tank with coils, closed top, ¼" T304, Agit.
- 1—450 gal. Stainless Steel Jkt'd. Agitated Kettle.
- 1—1500 gal. Steel Jkt'd. Vacuum Kettle.
- 1—Acme #8½ A Jaw Crusher, 9 x 16 opening; 20 HP motor.

## KETTLES—REACTORS

- 1 6 gal. Nickel Autoclave, agit. 1000# pr.
- 1 Stainless Steel, Type 347 Autoclave or pressure tank, 250# pr. Elec. heated 850° F; 17½" dia. x 9' high.
- 70 Stainless Steel and Stainless Clad open top, steam jacketed kettles—10, 40, 60, 80, 100, 150, 250, 500 gal. sizes.
- 1 Stainless Steel Kettle, 950 gal. 20# jkt. pr. vertical agitator. Type 347 shell, bolted C.I. top.
- 3 300 gal. T316 Stainless Steel Jacketed Tanks, 10# jkt. double motion agit.
- 1 200 gal. Read Stainless Steel Jacketed Kettle, double motion agit. 10 HP.
- 1 3000 gal. Horiz. Steel Cooker, Vacuum. Agitated.
- 4 Aluminum Reaction Kettles, Jkt'd. & Agit., 25, 60, 100 gal. and 250 gal.

## MILLS—PULVERIZERS

- 1 Paul Abbe #6 Pebble Mill, porcelain lined. 32" x 36".
- 1 Hardinge Conical Ball Mill. Steel Liner, 4½" dia. x 24" long.
- 1 Williams Hammer Mill, type AK; size A, stainless steel.
- 5 Mikro Pulverizers, #1-SH, #1-SI, #2-SI, #2-TH.
- 2 Premier Colloid Mills, 6" st. st. rotor, type U-3 & V-3.

## NOW LIQUIDATING

Equipment of Chemical Manufacturing and Distributing Co., Easton, Pa.:  
 1—Lightning Agitator 3 HP—431 RPM  
 1—Mikro Pulverizer #1-SI  
 1—Viking Rotary Pump, 3", 20 HP  
 1—1000 gal. Stainless Clad Tank  
 1—2000 lb. Jacketed Powder Mixer  
 2—Ribbon Mixers—1000#, 800#  
 Lot of Steel Storage Tanks, Kettles, mixing tanks, pumps, scales, etc.

## TANKS

- 35 Aluminum Tanks, closed, 4, 275, 330, 480, 500, 1350 & 1450, 9000 gal.
- 15 Horiz. Welded Steel Tanks, Lastiglas Lined, 15,200 gal.
- 1 Vertical Rubber Lined, 6000 gal. open.
- 5 Vertical Jacketed Pressure Tanks—Steel—30# steam jacket—6mm vacuum internally:  
 3—34" ID x 15' H (approx. 700 gal.)  
 1—23" ID x 10' H (approx. 230 gal.)  
 1—23" ID x 9' H (approx. 195 gal.)
- 8 15,000 gal. Vertical Welded Steel Closed Fermenting Tanks, 80 lbs. W.P., turbine agitator with 40 HP motor; 970 lin. ft. 3" pipe coll. Excellent condition.

## STAINLESS STEEL TANKS IN STOCK

- 1 3700 gal. Horiz. T304—NEW
- 1 4200 gal. Vert. closed, T304—NEW
- 1 1400 gal. Vert., open, 10' L x 37" W x 37" D
- 1 1000 gal. Vert. T316
- 50 Stainless Steel Tanks—from 9 gal. to 3000 gal.
- 8 3000 gal. Horizontal Stainless Steel Tanks, 5'4" dia. x 18'9" long, insulated and agitated. Excellent for transporting, storage or holding.

## MISCELLANEOUS

- 1 Bin, 275 cu. ft., T316, St. St.
- 2 Bird Susp. Centrifugals, 48" dia. Stainless Steel Perforated Baskets.
- 1 Fletcher 30" Jr. Centrifugal Extractor, St. St. Imperf. basket.
- 5 DeLaval Centrifuges, models #600, 74-11 and 94-01.
- 2 Kux Machine Co. Model 25 Rotary Pellet Presses, 21 and 25 punch.
- 3 Stokes Rotary Pellet Presses, 16 punch. B-2, D-3.
- 4 Selectro Vibrating Screens, stainless steel, 2' x 7', double deck, enclosed.
- 1 Stainless Steel Horizontal Sterilizer 10# pr. 24" W x 28" H x 36" L.
- 1 Stokes Vertical Steel Jacketed Vacuum Chamber and Impregnating tank, 30" L x 25" W x 24" D.
- 2 Vertical Agitators—40 HP gearmotor with Turbo #5B drive, 70 RPM.
- 1 Portier heavy duty jacketed double worm mixer—75 gal.

## STAINLESS STEEL FABRICATION

"Heliarc" welding. Water-quenched welds (if specified). Specializing in lighter weight tanks (10 gal., 12 gal., 14 gal., 16 gal., etc.). Large quantity of type 304 and type 316 sheets carried in stock assuring quick delivery of tanks built to your specifications. Over 30 NEW tanks in stock for immediate shipment—from 30 gal. to 5700 gal. sizes.  
 Write: Attn. Fabricating Division



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**EQUIPMENT CORP.**

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50 YEARS OF DEPENDABILITY IN  
AIR COMPRESSORS • VACUUM PUMPS**

A FEW REPRESENTATIVE UNITS FROM  
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80 CFM 6x5 Worthington HB  
122 CFM 7x7 Ingersoll ES-1  
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422 CFM 12½x11 American AF-1  
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Vertical Duplex Class-V-C  
18/11x10 with three Step Control  
885 CFM 100-125 Lb. 300RPM—150HP  
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Direct connected Synchronous or  
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#### NEW PORTABLE AND REBUILT — TESTED — GUARANTEED

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60 CFM Worthington (Gas) 2 Pneu  
70 CFM Smith (Gas) 2 Pneu  
105 CFM Ingersoll (Oil) 2 Pneu  
105 CFM Worthington (Gas) 2 Pneu  
105 CFM Worthington (Gas) 4 Pneu  
160 CFM Worthington (Gas) 2 Pneu  
160 CFM Worthington (Gas) 4 Pneu  
210 CFM Worthington (Gas) 4 Pneu  
215 CFM Worthington (Gas & Diesel)  
215 CFM Ingersoll (Oil) 4 Pneu  
500 CFM Worthington (Diesel) 4 Pneu  
600 CFM Worthington (Diesel) 4 Pneu

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60 CFM Ingersoll 6½x3½  
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130 CFM Ingersoll 10x5  
188 CFM Fuller C-40  
276 CFM Chicago 12x6  
356 CFM Penn 14x5  
720 CFM Worthington 18x7  
800 CFM Worthington 18x9  
1085 CFM Worthington 21x9  
1184 CFM Worthington 23x9  
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### Prompt Shipment—

**GLASS LINED TANKS — USED —** 3000 gallon capacity. Welded construction—fully insulated. Equipped with man-head. Suitable for milk, food products, oily white chemicals, solvents and fine lacquers.

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**MILLS—Pebble**, Lab. sizes, 30"x33", 6'x8'.  
**CONVEYOR**—NEW 24" Trouching with motors.

**EXHAUSTERS**—to 60000 cfm.

**PUMPS**—Centrifugal, New to 850 gpm. motors.

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**FILTER PRESSES**—24", 30", 36", 42". Some washing, open and closed delivery.

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#316 Stainless Steel Tanks, new, 100, 200 & 300 gal.  
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3—Day mixer, Steam Jacketed, 30 gal. Sigma Blade.  
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10—New Glass Nash Centrifugal Pump, 150 gpm.  
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Moat Mill #2 with 7½ H.P. totally enclosed motor & Driven Feeder—like new.  
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The above items include all auxiliary equipment with individual motor and control 220/440/3/60. The equipment may be inspected on foundations.

Complete List with Specifications Available.

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Powder mixers 50 to 2000 pounds  
Charlotte Colloid Mill M50—50 h.p. motor  
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Laughlin Horiz. Continuous Filter  
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Boilers 2 h.p. to 500 h.p. Oil or Gas Fired  
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ESTABLISHED IN 1899

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**Reactor**—100 Gal.—ASME—5.5. 304  
—NEW

**Reactor**—1000 Gal.—ASME—5.5. 304  
—NEW

**Blow Knox Autoclave**—Steel—Horizontal—Agit.—300# Int.

**Hersey Hot Air Dryer**—18" x 18"—complete

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RUST PROCESS DESIGN COMPANY  
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(Continued from page 458)

**ADMINISTRATIVE CHEMICAL** Engineer—Registered Professional Engineer, age 37, experienced production plant general superintendent, production manager, fifteen years chemical plant administrative experience in alcohol, whiskey, rayon-cellulose, fertilizer, sulfuric acid, soybean oil solvent extraction, submerged fermentations, yeast, riboflavin, Vitamin B-12. Also interested other fields. Very adaptable. PW-7174, Chemical Engineering.

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Companies interested in developing chemical manufacture in Australia should write in first instance to Managing Director,

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Learn why your western branch plant should locate in Metropolitan Oakland Area (MOA). This vigorous industrial center provides a rich, existing local market for chemical manufacturers selling to industry . . . and offers dead-center proximity to the entire multi-billion dollar West trading area. Hundreds of national firms PROFIT from MOA plant site advantages: all-season production; permanent year-round labor; low shipping rates; low shipping time and cost; major terminals for rail, truck, air, sea carriers; ideal, temperate climate; acres of level plant sites; excellent warehousing facilities; phenomenal, continuing G-R-O-W-T-H. For your free Data sheets on climate, markets, distribution, etc.—or for answers to specific questions, write:

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### AVAILABLE CUSTOM REFINING FACILITIES

- Distillation • Extractions
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Dyes - Chemicals - Pigments - Waxes  
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Vacuum Dryers, Heavy Duty Mixers, Reactors, Kettles, Columns, Rotary Filter, Pulverizers, Filter Presses, S/S and non corrosive Tankage, Idle or Set Up Plant.

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We are now manufacturing over \$20,000,-  
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2 ONLY—1500 KW Westinghouse rotary converters, 250 DC Volts, 6000 DC amperes, 6 phase 60 cycle, 450 RPM, each with 13.8KV transformers, and AC and DC switchgear. Top operating condition.

2 ONLY—1500 KW Westinghouse rotary converters, 270 DC Volts 5580 DC amps 6 phase 60 cycle 450 RPM, each with 13.8KV transformers and AC and DC switchgear. Make us an offer.

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Bowen Lab Model 837—Stainless 36 KW—  
Air Heater—440 Volt.

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Welsbach Type C9-55—With 120V/240V  
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Link Belt Single RH Box Car Type—5 HP  
440V-3PH Reduction 155 RPM.

#### MAGNET

Bings Heavy Duty Model Big Electronic  
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Harrison, N. J.

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✓ LAYAWAY PLAN A deposit will hold

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54x126" Whitlock storage tank with copper heating coils for heating 6000 gallons of water from 40° F to 180° F. With steam at atmospheric pressure. Tank built for 100 lb. working pressure. Coils can be used with steam at 100 lbs. working pressure.

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- 2—5000 gal jktd & agtd steel vac kettles
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- 1—Devine 1200 gal jktd & agtd Cl still
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- 10—Stokes & Kelly s/s reactors 125-500 gal
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**DRYERS**

- 1—Buflovak atmospheric double drum dryers 5' x 12'
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**CENTRIFUGALS & FILTERS**

- 14—Sharples monel pressuret super centrifuges explosion proof
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- 2—24" Shriver 4 eye 24 chambers filter presses closed Cl
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- 1—Johnson 24" Cl filter press 3 eye closed 13 chambers
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- 1—Burkhardt 40" herosite coated lead lined curb centrifuge
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- 1—International 8" copper perforated basket centrifuge
- 1—Bock 17" s/s perf basket centrifuge

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- 1—Mikro steel Bantam pulverizer
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- 1—Sprout Waldron attrition mill 10 HP
- 1—Jeffrey type A hammermill, 10 HP
- 1—Ball & Jewell #1 rotary cutter
- 1—Abbe laboratory grinder
- 1—Buehler 5 roll 12" x 32" high speed water cooled roller mill
- 1—J. H. Day 5" x 12" lab 3 roll mill
- 1—Hardinge 4' x 14'6" granite lined tube mill
- 1—New Charlotte #3 monel colloid mill

**EVAPORATORS & CONDENSERS**

- 2—100 sq. ft. 316 s/s heat exchangers
- 1—75 sq. ft. s/s tubular condenser
- 7—condensers 4 sq. ft. type 316 s/s
- 6—Vogt direct expansion coolers, 7 pass s/s clad 10' x 34', 19,000 gals
- 1—New lead 66 sq. ft. condenser
- 2—Devine 45 sq. ft. surface condensers
- 1—Pfaudler 14 sq. ft. G/L thimble condenser
- 1—Zahn copper flash evaporator 500#/hr
- 1—48" x 16' s/s 304 absorber w/4 trays having 19—6" OD bubble caps

**MIXERS—ALL TYPES**

- 2—7500# dry powder mixers—galvanized
- 1—Szegvari attritor type B 60 gal 5 HP
- 40—Lightnin' Also portable agitators ¼ to 2 HP AC & DC
- 19—Netto, Phila., Foote Bros., Link Belt, Falk agit drives 2 to 10 HP 5 to 70 RPM
- 1—Robinson Size 15 cont 3-5 ton/hr mixer
- 10—Day 100 to 2000 lb powder mixers
- 2—Day 10 gal double arm mixers
- 1—W & P 2½ gal double arm sigma mixer
- 2—Hobart 80 quart mixers
- 1—Wall post mixer, 1 HP XP
- 8—Day & Peerless single & double arm 50 to 300 gal mixers

**SIFTERS**

- 1—Rotex #41 sifter, 40" x 10' single deck
- 1—Rotex 20" x 84" sifter, single deck
- 1—Rotex 20" x 60" sifter s/s 4 separations
- 1—Tyler #38 sifter, 48" x 50"
- 1—Robinson 32" x 72" sifter 4 separations
- 3—Coombs Gyrotary 20" sifters

**TANKS**

- 3—9800 gal s/s 304 tanks, 9' x 14'9" dished heads
- 7—10,000 gal oil steel storage tanks
- 4—s/s tanks, 1000, 1400, 1500, 1600 gals
- 3—900 & 1200 gal s/s 316 rect tanks
- 2—3000 gal Pfaudler g/l tanks

**MISCELLANEOUS**

- 4—Colton auto tube fillers, #17, 7, 4 & 2
- 1—Capem 4 head cappers
- 1—Kinex Model M semi-automatic copper
- 1—Shriver diaphragm pump, 15 GPM
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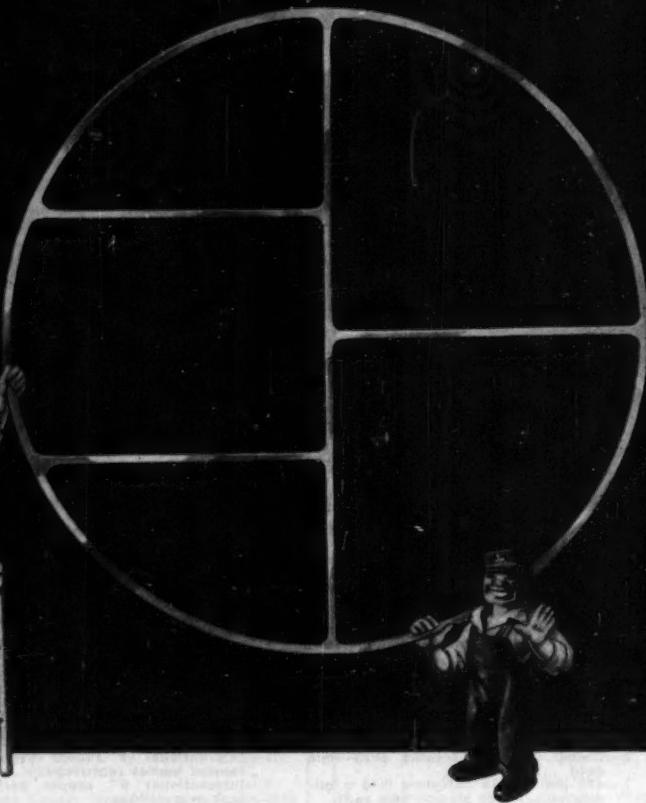


*Hand-tailored to any size you need...*

**LARGE**

**or**

**SMALL**



## ...Goetze Heat Exchanger Gaskets are precision-made for longer service

Whether your requirements call for heat exchanger gaskets larger than 100" in diameter, or smaller than 10", you can get the exact size you want . . . hand-tailored to the shape you need . . . simply by specifying "Johns-Manville Goetze."

And because they're *precision-made*, you'll find these better gaskets provide the effective sealing and longer life that make them actually cost less in the long run. Each gasket is carefully constructed in every detail to assure accuracy of fit

. . . to provide ample lap widths and uniform rib widths . . . and to prevent trouble-making wrinkles or cracks on the corners.

If you're having trouble with persistent joint leakage and frequent gasket replacements, find out how little it costs to have Goetze Heat Exchanger Gaskets tailored to your requirements. Your blueprint or template will bring a prompt estimate. Address Johns-Manville, Box 60, New York 16, New York.

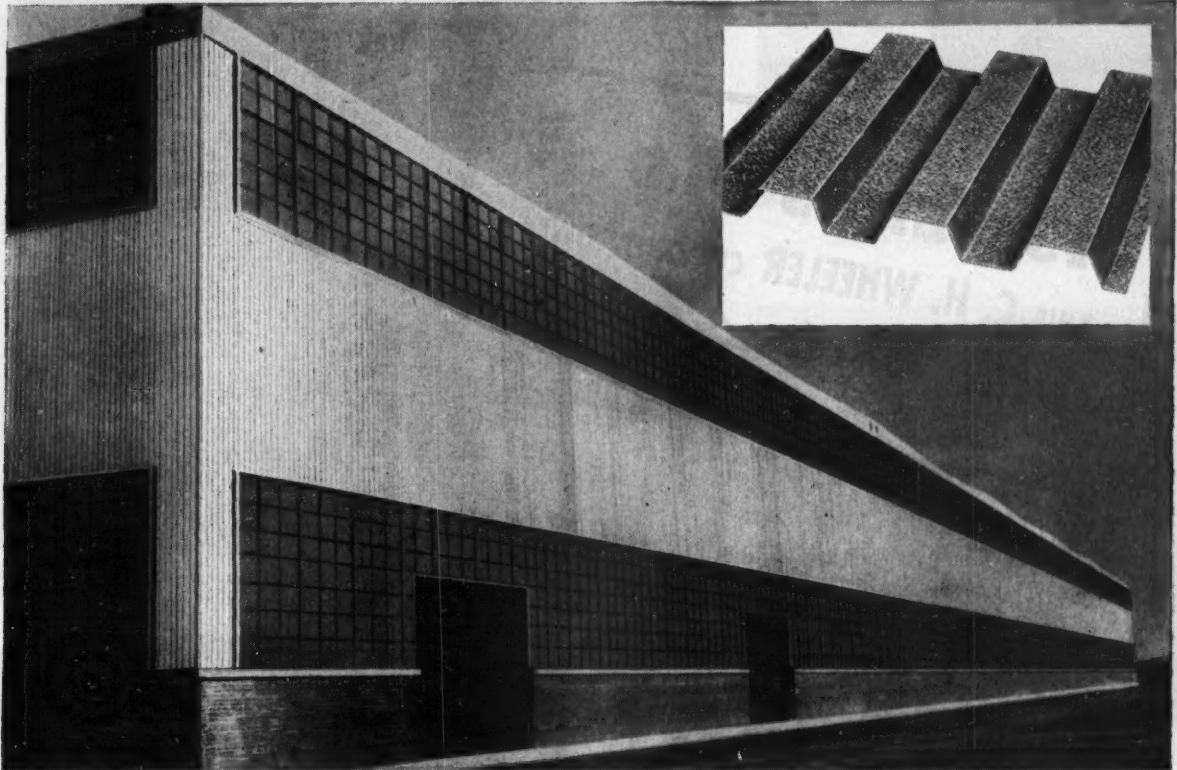


**Johns-Manville** *Goetze* **GASKETS**

THERE'S A JOHNS-MANVILLE PACKING  
AND GASKET FOR EVERY SERVICE

April 1953—CHEMICAL ENGINEERING

# NOW...ALUMINUM INDUSTRIAL SIDING WITH MODERN ARCHITECTURAL BEAUTY!



General Contractors:  
Turner Construction Co., Struck Construction Co.

One of the many large units at "Appliance Park," Buechel, Ky., where General Electric will consolidate its major appliance manufacturing. This new siding used throughout.

Here's the siding material industry has long sought! Sharp vertical lines in modern design, with all the advantages of rustproof, corrosion-resistant aluminum...low applied cost, long life, low maintenance (no painting), strength with light weight, heat-reflection that improves interior comfort summer and winter. No wonder this is what General Electric chose for siding throughout its vast new Appliance Park project. It ranks tops with archi-

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Call Reynolds for literature and technical assistance on this new siding. For a material that performs as both roofing and siding, ask about Industrial Corrugated. Offices listed under "Building Materials" in classified phone books of principal cities. Or write

Reynolds Metals Company, Building Products Division, 2042 South Ninth Street, Louisville 1, Kentucky.

#### SPECIFICATIONS:

METAL THICKNESS: 0.032" (22 U. S. Std. Ga.).

FINISH: Stipple-embossed.

LENGTHS: 5', 5½', 6', 6½' and so on to 13½'; also 13' 10". Special lengths to order.

WIDTH: Over-all width 33%, nominal coverage 32".

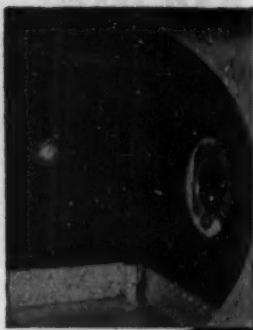
RIBS: Pitch 4" center to center, depth 1".

WEIGHT: 59 lbs. per 100 square feet.

Military demands for aluminum reduce supply, but Reynolds is rapidly expanding production. Rated orders receive priority handling.

## REYNOLDS *Lifetime* ALUMINUM RIBBED-EMBOSSED SIDING

SEE "MISTER PEEPERS," starring Wally Cox, Sundays, NBC Television Network. HEAR "Fibber McGee and Molly," Tuesdays, NBC Radio Network.



Looking into well-kept water basin through fan port. Glass port at right and interior lighting permit engineering students to observe break-up and distribution of cooling water.

**45 YEARS OLD . . .**  
**THIS C. H. WHEELER COOLING TOWER**  
**Still Works Like New**

At the Towne Scientific School of the historic University of Pennsylvania in Philadelphia a C. H. Wheeler Water Cooling Tower has been in service since 1906. It was the first mechanical draft cooling tower built by the C. H. Wheeler Mfg. Co. and some believe it is the first one built in this country.

In all these years the wood fill has never required replacement. It's still distributing and breaking up cooling water as efficiently as the day it was first put in service. The inside metal casing has never required repairing above the water basin area. Another smaller C. H. Wheeler Cooling Tower has also served this engineering school for several decades. Both are forced draft towers.

These are but two of many C. H. Wheeler towers that have stood for twenty years and more, as testimony to the quality of workmanship and materials that go into every tower we build. Of course, length of service depends on proper care. C. H. Wheeler engineers have prepared a "Blue print for Operating and Maintaining Mechanical Draft Cooling Towers." A request on your company letterhead will bring your copy promptly by mail.

114  
**C. H. WHEELER of Philadelphia**

COOLING TOWER DIVISION, 407 S. DEARBORN STREET, CHICAGO 5, ILL.

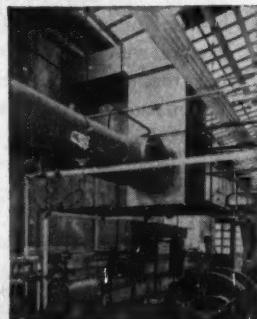
Steam Condensers • Cr. Pumps • Axial and Mixed Flow Pumps • Steam Jet Ejectors • Cooling Towers • Vacuum Refrigeration  
Water Treatment • Filtration • Dewatering • Grit Removal • Air Reduction Mills • Marine Condensers and Ejectors • Deck Machinery.



First C. H. Wheeler forced draft tower built in 1906. 4'3" x 6' x 53'9" high. Metal casing.



Another, smaller C. H. Wheeler water cooling tower suspended from beams in another section of the Towne Scientific School.





**G-E LIMITAMP** controls operation of synchronous and induction motor drives—will protect equipment under short-circuit conditions as high as 250,000 KVA.

## G-E Limitamp Control— Provides Greater Safety At High Voltages

**G-E Limitamp** is a high voltage motor starter providing interrupting capacity up to 4800 volts . . . gives you quick, silent short-circuit protection for motors up to 2250 hp.

**Heavy duty air-break contactors** with improved arc-icing structure permit a rapid duty cycle for millions of operations . . . require little maintenance.

**High interrupting capacity** plus fast-acting, specially developed EJ-2 fuses, (which limit fault current to less than  $\frac{1}{4}$  cycle,) provide complete motor protection . . . prevent costly shutdowns.

**For safety of maintenance personnel** high and low voltage compartments are separated by a steel barrier. Mechanical door interlocks assure motor circuit interruption before the fuse compartment door can be opened.

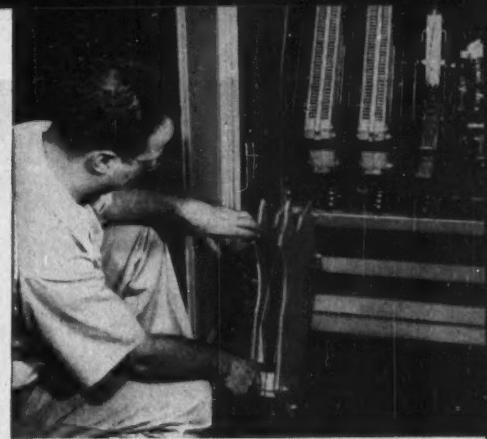
**G-E engineers study your requirements** . . . design all components into a co-ordinated "package" that will give you adequate interrupting capacity for your system.

**G-E Limitamp controls** are delivered totally assembled, ready for service and need only be put in place, the leads connected, fuses inserted . . . the control is ready to operate.

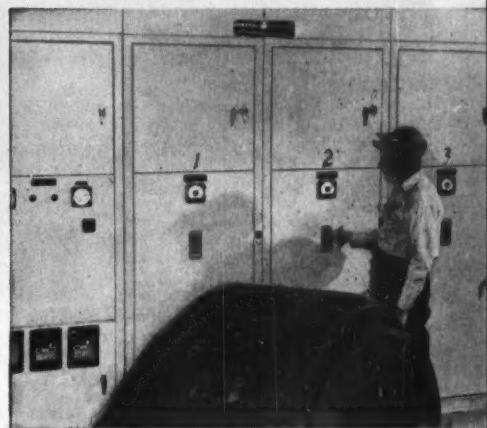
**For complete information** contact your G-E Representative, or write for Bulletin GEA-5409A, General Electric Co., Sec. 781-3, Schenectady 5, N. Y.

*You can put your confidence in—*

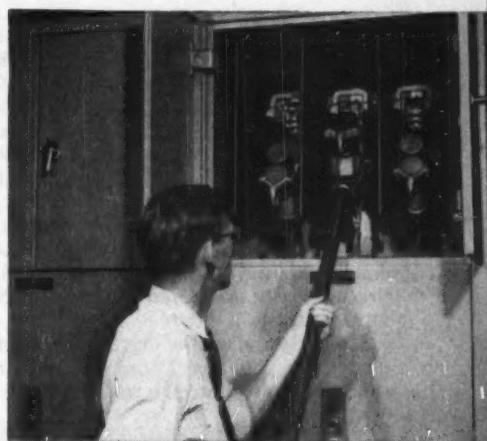
**GENERAL ELECTRIC**



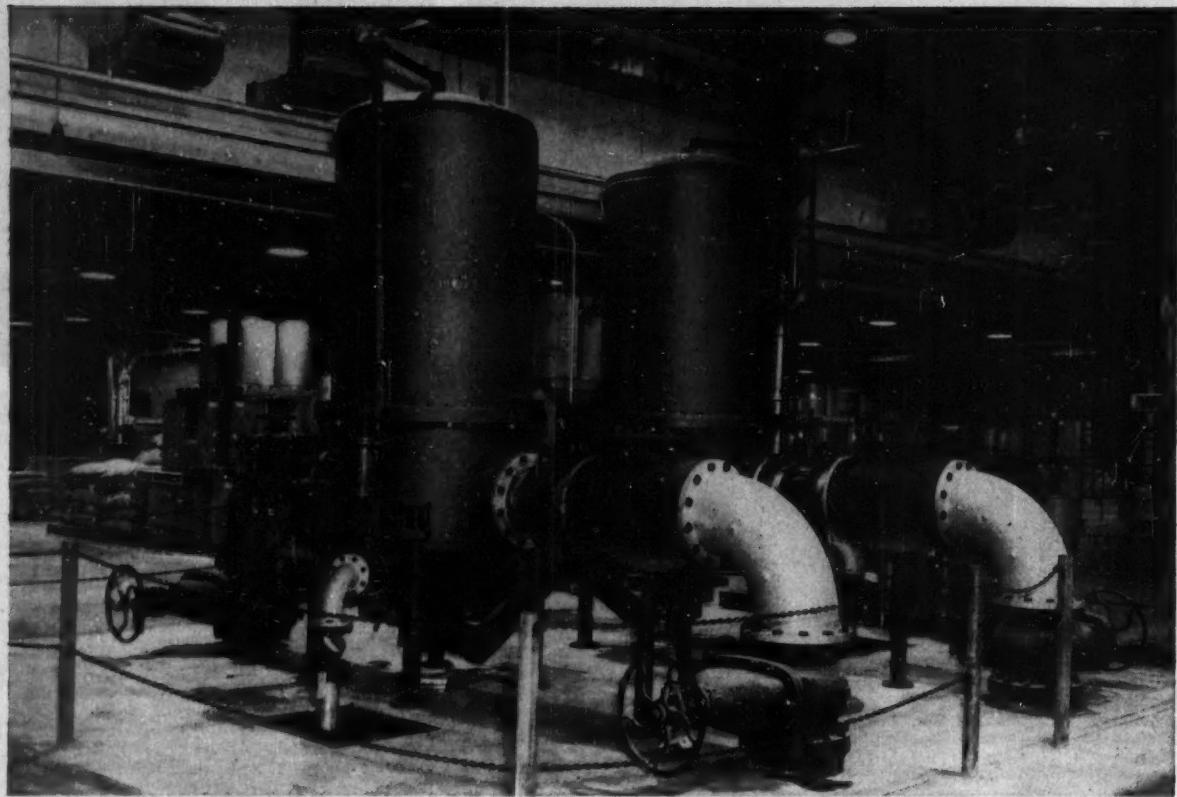
**MAINTENANCE IS EASY**—for example: arc shutters can be removed quickly, contact tips inspected, and your Limitamp control is right back in operation.



**SIMPLE TO OPERATE**—G-E Limitamp control permits pushbutton operation for manual starting and stopping while meters provide a quick check on load.



**FUSES ARE EASILY REPLACED**—when the fuse swings forward on its hinge, it is easily lifted out and quickly replaced with the help of a switch hook.



EVERY GRAIN OF SAND IS REMOVED from the well water passing through these abrasion-resistant FLO-KLEAN filters at the new Upjohn Company plant in Kalamazoo, Michigan.

## Upjohn saves 2000 dollars a month

### FLO-KLEAN filters protect valuable equipment at pharmaceutical plant

Maintenance records at the Upjohn Company's ultra-modern plant near Kalamazoo, Michigan, show that FLO-KLEAN filters are responsible for saving up to \$2000 a month in maintenance costs.

These Cuno FLO-KLEAN filters, used to remove sand and gravel from incoming well water, ordinarily take something like a teaspoon of sand out of each thousand gallons. That doesn't appear to be an impressive quantity, but it could cause serious damage to stainless steel valves, pumps, water softeners, condensers and other valuable equipment. Purity of process water is assured by the high-capacity FLO-KLEAN units.

Recently the wall of one of their thirteen 250 feet deep wells gave way, dumping large quantities of sand and gravel into the water system. Every bit of

this sudden deposit (almost seven cubic yards) was removed by the FLO-KLEAN filters. Without interrupting service, FLO-KLEAN continued its automatic operation and saved Upjohn a serious operating and maintenance loss.

In hundreds of applications throughout industry the fully automatic, continuously self-cleaning FLO-KLEAN filters have paid for themselves many times over by making river, lake, or well water fit for industrial use . . . and without loss of backwash water. Other uses include reclaiming industrial process water and coolants. If you need or use between 200 and 100,000 gallons per minute of clean water, find out how FLO-KLEAN can save you money. Write for free FLO-KLEAN bulletin to the Cuno Engineering Corporation, Dept. 101F Meriden, Conn.

3.1



## ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type)

MICRO-KLEAN (fibre cartridge)

FLO-KLEAN (wire-wound)

## ADVERTISERS INDEX

For more information about products of these advertisers, use Reader Service postcard in section following

Admiral Tool & Die Company.....	T346	Crane Packing Company.....	336	Gas Atmosphere, Inc.....	408
Air Preheater Corp.....	50	Croll-Reynolds Co.....	341	General Amer. Transp. Corp.....	12, 245, 283
Airetool Mfg. Co.....	252	Crouse-Hinds Company.....	34	General Chemical Div. of Allied Chem.	
Albert Pipe & Supply Company.....	B298	Crucible Steel of America.....	432	& Dye Corp.....	113
Allis Chalmers Mfg. Company.....	27, 81, 103	Cuno Eng. Co.....	474	General Dynamics Corp.....	334
	145, 289	Dampney Company, The.....	132	General Electric Company.....	78, 180-191
Allis-Chalmers Mfg. Co. (Tractor Div.).....	87	Darco Dept. Atlas Powder Co.....	85	Gifford Wood Company.....	447, 473
Allmetal Screw Products Co.....	T352	Darnell Corporation, Ltd.....	M396	Girdler Corp.....	179
Alloy Steel Products Co., Inc.....	18	Davenport Machine & Fdry. Co.....	B140	Globe Steel Tubes Company.....	402
Aluminum Co. of America.....	143			Glycerine Producers Assoc.....	399
American Blower Company.....	75			Golden Anderson Valves Co.....	130
American Brass Company.....	79			Goodrich Company, The B. F.....	15
American Car & Foundry.....	137, 387			Goodrich Chemical Co.....	17
American Flange & Mfg. Co.....	25			Goslin-Birmingham Mfg. Co., Inc.....	L400
American Hard Rubber Company.....	247			Goulds Pumps, Inc.....	378
American Metal Hose.....	177			J. W. Greer Company.....	164
American Optical Company.....	14			Grinnell Company, The.....	8
American Platinum Works.....	254			Groen Mfg. Co.....	B310
Annin Co.....	64				
Ansul Chemical Company.....	152, T298			Hagan Corp.....	49
Anti-Corrosive Metal Products Co., Inc.....	320			Hammond Bag & Paper.....	T384
Atkomatic Solenoid Electric Valves.....	95			Hardinge Company, The.....	365
Atlas Powder Company.....	433			Harshaw Chemical Co.....	32
				Hartwell & Sons, Inc. H. N.....	299
Badger Mfg. Co.....	350			Havex Corp.....	131
Bailey Meter Company.....	84			Haynes Stellite Company.....	291
Baker & Adamson Products, Chem. Gen. Div. Allied Chem. & Dye Corp.....	271			Heil Process Equip. Co.....	456
Baker & Company, Inc.....	26, 381			Hensley Company.....	R396
Baldwin-Hill Company.....	270			Helicoid Gage Div. Amer. Chain & Cable	
Barber-Greene Co.....	RB385			Company.....	286
Barco Mfg. Company.....	80			Heyl & Patterson, Inc.....	21
Barrett Div. of Allied Chem. & Dye Corp.....	454			Hills-McCanna Company.....	160
Beckman Instruments Co.....	L438			Homestead Valve Mfg. Co.....	183
Bell & Gossett Co.....	153			Hoover Electrochemical Company.....	445
Bemis Bros. Bag.....	144			Hough Company, Frank.....	90
Berkley Scientific Div. of Beckman Instruments Inc.....	125			Hudson Pulp & Paper Corp.....	442
Bersworth Chemical Company.....	338				
Bethlehem Foundry & Mach. Co.....	288			Illinois Testing Labs. Inc.....	L437
Bethlehem Steel Co.....	155			Industrial Process Engineers.....	47
Bird Machine Company.....	11			Infico Inc.....	255
Black, Sivals & Bryson, Inc.....	82			Ingersoll-Rand.....	439
Blaw Knox Equip. Div. of Blaw-Knox Co.....	339			Insul-Mastic Corporation.....	107
Bourn Labs.....	M416			International Engrg. Inc.....	157
Bowser Inc.....	B328			International Nickel Company.....	426
Bridgeport Brass Company.....	450			I.T.E. Circuit Breaker Company.....	170-171
Bristol Co.....	448				
Brookfield Eng. Labs, Inc.....	RB348			Jefferson Chemical Company, Inc.....	379
Brown & Root, Inc.....	119			Jeffrey Mfg. Co.....	420
Buffalo Forge Co.....	455			Jellif Mfg. Company.....	B326
Buffalo Pumps, Inc.....	453			Jenkins Bros.....	45
Bušovák Eqpt. Div. Blaw-Knox.....	392			Jerguson Gage & Valve Corp.....	366
				Johns-Manville.....	265, 313, 470
Cambridge Wire Cloth Company.....	358			Joy Mfg. Company.....	397
Carbide & Carbon Chemical Co., Div. Union Carbide & Carbon.....	267				
Carborundum Co., The.....	165			Kaiser Aluminum & Chemicals Sales Inc.....	423
Carpenter Steel Company.....	172			Kalamazoo Tank & Silo Company.....	T141
Cash, A. W. Co.....	273			Keasbey & Mattison Company.....	68
Century Electric Company.....	415			Kelley & Co., O. G.....	28
Chapman Valve Mfg. Company.....	52			M. W. Kellogg Co.....	389
Chase Bag Co.....	86			Kemp Mfg. Company C.....	434
Chase Brass & Copper Co.....	444			Kewanee-Ross Corp.....	55
Chemical Const. Corp.....	428			Key Co.....	176
The Chemical & Industrial Corp.....	92			Kidde & Company, Walter.....	266
Chemsteel Const. Co.....	456			Kimberly-Clark Corporation.....	182
Chicago Bridge & Iron Company.....	452			Kold-Hold Mfg. Company.....	259
Chiksan Co.....	441			Koppers Company, Inc.....	44, 169, L435
Clark Bros. Company.....	251			Koven & Bros. Inc.....	394
Clark Equip. Co.....	248			Kinney Mfg. Co.....	407
Cleaver-Brooks Company.....	161				
Cleveland Mixer Co., The.....	456			LaBour Company.....	24
Cleveland Worm & Gear Company.....	111			Ladish Co.....	35
Colorado Iron Works Co.....	LB421			Lapp Insulator Company.....	261, 405
Combustion Engineering-Superheater, Inc.....	280			Lawrence Mach. & Pump Corp.....	386
Consolidated Engineering Corp.....	429			Layne & Bowler Inc.....	133
Cooper Alloy, The.....	91			Leeds & Northrup Company.....	443
Coppus Engng. Corporation.....	69			Leslie Company.....	440
Corning Glass Works.....	354-355			Link-Belt Company.....	13, 51, 307
Crane Company.....	279			Liquidometer Corporation.....	T326

Louisville Dryer Div. of Gen. Amer.	245	Reliance Electric & Eng. Co.	287
Transp. Corp.	245	Republic Flow Meters Co.	319
Lubriplate Div. Fiske Brothers Refining Co.	1401	Republic Steel Corporation	301, 398
Magna Mfg. Co., Inc.	456	Revere Copper & Brass, Inc.	373
Manning, Maxwell & Moore, Inc.	395	Reynolds Metals Co.	471
Marietta Concrete Corp.	1411	Rietz Mfg. Co.	1403
Marley Company, Inc., The	9	Rodney-Hunt Machine Co.	309
Master Elec. Company	3rd Cover	Roosevelt Oil & Refining Corp.	391
McDanell Refractory Porcelain	R438	Roots-Connersville Blower Corp.	383
Mehl Mfg. Co.	T314	Russell & Stoll Co., Inc.	B297
Merrick Scale Mfg. Co.	456	Ryerson & Son, Inc., J. T.	188
Metal Textile Corporation	M401	Safety Car Heating & Ltd., Entelete Div.	377
McGraw-Hill Book Co.	L416	Saran Lined Pipe Company	142, 411
Mercoind Corp.	RT435	Sarco Company, Inc.	39
Michigan Pipe Company	362	Sauereisen Cements Co.	456
Michigan Wheel Company	RB384	Schmiege Industries, Inc.	B325
Micro Metallic Corp.	300	Schneible Company, Claude B.	B352
Midwest Piping & Supply Co.	424	Schutz-O'Neill Co.	74
Miller, Ray	LB384	Sealol Corp.	139
Minneapolis-Honeywell Regulator Company Industrial Div.	20, 418-419	Shriner & Company, T.	T312
Mixing Equipment Company, Inc.	241	Sier-Bath Gear & Pump Co. Inc.	159
Monarch Mfg. Works, Inc.	R404	Simpson Mix-Muller Div. of National Eng. Co.	427
Monsanto Chemical Company	174-175	W. W. Sly Mfg. Company	127
Multi-Metal Wire Cloth Co., Inc.	T310	A. O. Smith Corporation	306
A. B. Murray Company	R396	Solvay Process Div. Allied Chem. & Dye Corporation	269
Nash Engrg. Company	446	Sparkler Mfg. Company	304
Natl. Airoil Burner Company	L404	Spence Eng. Company, Inc.	349
National Aluminate Corporation	317	Spray Engineering Co.	T328
Natl. Carbon Div. Union Carbide & Carbon Corp.	295	Sprout Waldron & Company	360-361
Natl. Engrg. Company	427	Standard Oil Company, Indiana	73
National Filter Media Corp.	R403	W. W. Stanley, Inc.	421
New England Tank & Tower Co.	126	Stephens Adamson Mfg. Co.	345
Neville Co., The	173	Stokes Machine Company, F. J.	331
Niagara Alkali Company	154	Stone & Webster Engng. Corp.	37
Niagara Filter Div., American Machine & Metals, Inc.	10	Struther Wells Corporation	412
Nicholson & Company, W. H.	B312	Sturtevant Mill Company	347
Nordstrom Valves Div. of Rockwell Mfg. Co.	88-89	Sun Shipbuilding & Dry Dock Co.	422
Norton Company	178	Superior Electric Co.	359
Norwalk Co., Inc.	158	Sutton Steele & Steele Inc.	M437
Ohio Injector Co.	33	Swenson Evaporator Company	6-7
Ohmart Co.	R416	Taber Pump Company	364
The Oilgear Co.	135	Tank Storage Terminals Div. of Gen. Amer. Transp. Corp.	283
Oldbury Electro-Chem. Co.	T140	Taylor Instrument Companies	357
Omega Machine Company	417	Taylor Forge & Pipe Works	353
Oronite Chemical Co.	48	Texas Gulf Sulphur Company, Inc.	99
Panalarm Products Inc.	316	Thomas Alabama Kaolin Co.	T348
Pangborn Corp.	388	Titellex, Incorporated	R401
Patterson Foundry & Machine Co.	46	Trane Company	351
Patterson-Kelly Company	185	Traylor Engrg. & Mfg. Co.	83
Peerless Pump Div.	186	Trent Tube Co.	330
Pennsylvania Industrial Chemical Corp.	54	Trerice, H. O.	136
Permutit Company, The	58	Tri-Clover Machine Co.	108-109
Petro-Chem Development Co., Inc.	121	Tube Turns, Inc.	409-410
Pfaudler Company	315, 4th Cover	Turner & Haws Eng. Co. Inc.	321
Pfizer & Company, Inc. Chas.	343	Union Bag & Paper Corporation	19
Philadelphia Gear Works Inc.	311	Union Carbide & Carbon Corp., Carbide & Carbon Division	267
Pittsburgh Agricultural Chemical Co. Div. of Pitts. Coke & Chem. Co.	425	Union Special Machine Co.	R437
Pitts. Corning Corp.	61	U. S. Gasket Company	257
Pittsburgh Lectrodryer Corp.	65	U. S. Industrial Chemical Co.	71-72, 323
Pneumatic Scale Corp., Ltd.	408	U. S. Rubber Company	56
Potter Aeronautical Co.	305	U. S. Stoneware Company	104
Horace T. Potts Co.	187	Van Dorn Iron Works Co.	285
Powell Company, Wm.	436	Victor Chemical Works	96-97
Prater Pulverizer Co.	R451	Victory Eng. Corp.	146
Pressed Steel Tank Co.	63	Viking Pump Co.	T342
Proctor & Schwartz, Inc.	184	Virginia Carolina Chem. Corp.	406
Process Controls Div. of Baird Associates.	124	Virginia Smelting Co.	134
Process Div. of Gen. Amer. Transp. Corp.	12	Vogt Machine Company, Henry.	38
Prufcoat Laboratories, Inc.	296	Wagner Electric Corp.	375
Pyrene Mfg. Co.	344	Wall Colmonoy Corp.	376
Raybestos Manhattan Inc. Man. Rubber Div.	168	Wallace & Tiernan Co., Inc.	147
Raymond Pulverizer Div., Combustion Eng.-Superheater Co.	280	Walworth Company	327
Read Standard Corp.	272	Warren Steam Pump Company, Inc.	368
Reichhold Chemicals, Inc.	117	Watson-Stillman Fittings Div. of H. K. Porter Co., Inc.	57
Waukesha Foundry Co.	B346	Welding Fittings Corporation	333
Welsbach Corporation	303	Western Electrochemical Co.	T325
		Westinghouse Electric Corp., Air Conditioning Division	393
		Westinghouse Electric Corp., 53, 371, 430-431	
		Weston Elec. Inst. Company	151
		C. H. Wheeler Mfg. Co.	472
		Wigton-Abbott Corp.	363
		Willsey & Sons, Inc., A. R.	414
		Wilson Inc., Thomas C.	150
		Williams & Company, C. K.	318
		Williams Patent Crusher & Pulverizer Company	166
		Wolverine Tube Div. of Calumet & Copper Co.	329
		Worklon, Incorporated	RB435
		Worthington Corp.	76-77, 367
		Wyandotte Chemicals Corp.	167, 369
		Yarnell-Waring Company	163
		York Co.	449
		Young Radiator Co.	B314

#### PROFESSIONAL SERVICES ..... 457

##### SEARCHLIGHT SECTION (Classified Advertising) H. E. Hiltz, Mgr.

##### EMPLOYMENT

Positions Vacant	458, 468
Positions Wanted	458, 468
Selling Opportunities Wanted	468
Employment Agencies	458
Employment Services	458

##### SPECIAL SERVICES

Contract Work	468
---------------	-----

##### BUSINESS OPPORTUNITIES

Offered	468
---------	-----

##### PROPERTY

For Sale	468
Wanted	468

##### EQUIPMENT (Used or Surplus New)

For Sale	459-469
----------	---------

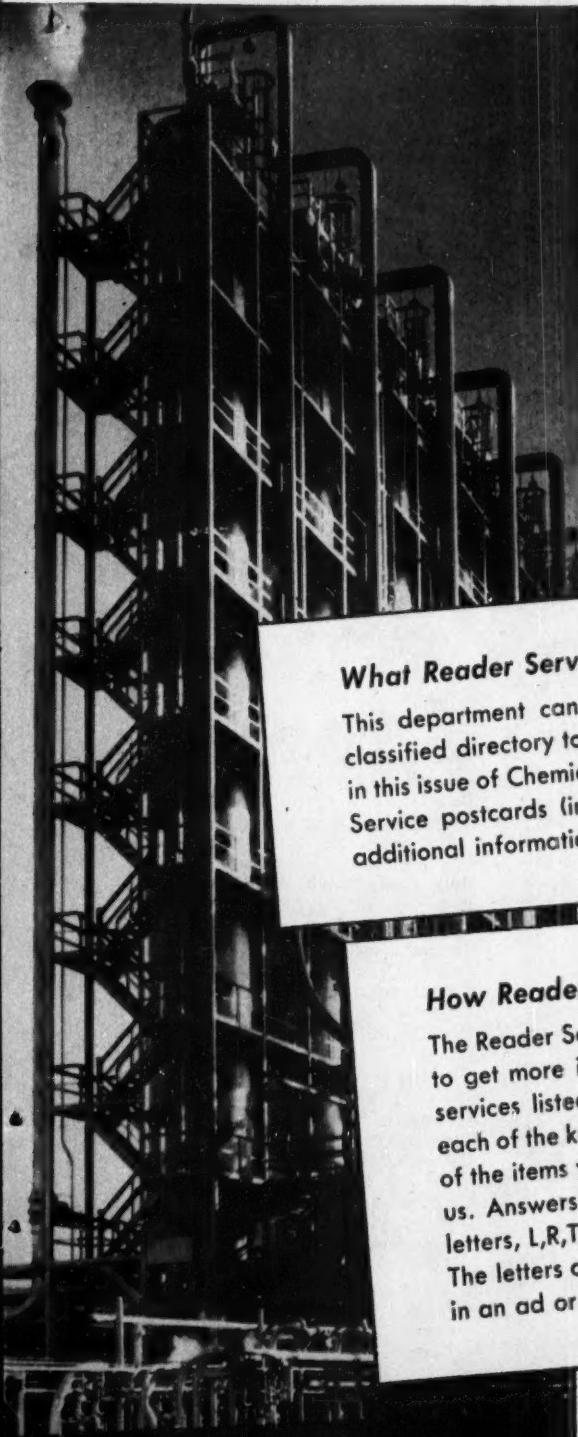
##### WANTED

Equipment	468
-----------	-----

##### ADVERTISERS INDEX

Aaron Equipment Co.	464
American Air Compressor Corp.	466
Arthur Process Equipment Co.	466
Barcan Co., Irving	469
Brill Equipment Co.	463
Chemical & Process Machinery Corp.	469
Chemical Service Corp.	468
Consolidated Products Co., Inc.	459
Cummings-Landau Laundry Machinery Co.	468
Dalton Supply Co.	462
Drake Personnel Inc.	458
Edwards Steel Drum	466
Electric Equipment Co.	462
Equipment Clearing House Inc.	464
Fratl Machinery Corp.	457
Gale, C. J.	468
Geib & Sons, Inc., R.	461
Heat & Power Co.	462
Heinlein Inc., W. P.	462
Kehoe Machinery Corp.	466
Lawier Company	466
Lestan Corp.	462
Loeb Equipment Supply Co.	460
Luken's Steel Co.	466
Luria Steel & Trading Corp., Erman-Howell Division	466
Machinery & Equipment Co., (Calif.)	468
Machinery & Equipment Co., (N.Y.C.)	462
Marvin Co., George R.	462
Metropolitan Oakland Area	468
Newman Tallow & Soap Machinery Co.	466
Nopco Chemical Co.	468
Olin Industries	463
O'Neill, A. J.	460
Pennsylvania Salt Mfg. Co.	468
Perry Equipment Corp.	465
Rust Engineering Co., The	468
Selective Placement	458
Sharples Corp., The	468
Stanhope, Inc., R. C.	464
Stein Equipment Co.	464
Strickler & Assoc., Dean C.	462
Sundfelt Equipment Co., Inc.	464
Truland Chemical & Engneering Co.	468
Union Standard Equipment Co.	460
Vulcan Detinning Co., The	466

# *Chemical Engineering* Reader Service



• CHEMICALS

• EQUIPMENT

• SERVICES

## What Reader Service Does for You...

This department can serve you in two ways. It is a complete classified directory to equipment, chemicals and services offered in this issue of Chemical Engineering. It is also a key to the Reader Service postcards (inside back cover) that will bring you free additional information on any of the listed items.

## How Reader Service Works...

The Reader Service postcards inside the back cover make it easy to get more information on any of the chemicals, equipment or services listed here. Each card has corresponding numbers for each of the key page numbers in this directory. Circle the numbers of the items you want; fill out the return address; mail the card to us. Answers will come direct to you from the companies. The letters L,R,T,B, locate ads on the page: left, right, top, bottom. The letters a,b,c and A,B,C indicate first, second, third, etc., item in an ad or on a particular page.



# Chemical Engineering Reader Service

## CHEMICALS-EQUIPMENT-SERVICES

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## CHEMICALS

Adhesive	264C
Alkalies	269
Alumina	423
Ammoniated molasses	364V
Ammonium salts	272C
Bacteriostat, actamer, for toilet preparations	174-175a
Carbon, activated, Darco	85
Carbonate of potash	154
Catalyst & catalyst supports, aluminas	143
Catalysts, platinum metals	381
Catalysts, preformed	32
Caustic soda, in open head drums	369
Chelating agents, versenes	338
Chemicals	362R
Chemicals	
Castor oil	364E
Pharmaceutical	364D
Chlorates & perchlorates	T325
Chlorinating agents	445
Citrazinic acid	263C, 343
Coal chemicals	425
Coatings	
Fire retardant	366B
Nickel	366U
Protective	132, 365H
Protective	
Coal-tar, pitch base	169
Primer and vinyl top coat	296
Vapor and weather	107
Colors and pigments, technical selection data	318
Detergent	362O
Detergents, krelon	167
Diethyl malonate	67
Mimethyl isophthalate	264A
Electrochemicals	T140
Fatty acids	364P
Fluid catalyst, method of determining particle size	335c
Fuel oil additive	264B
Gallium	262B
Germicide, santophen 1	174-175c
Glycerine, for alkyd resins & ester gums	399
Heat sealing compound	272A
High boiling phenols	268A

Koalinite, koalinitic, colloidal	T348
Lubricant	262C, 362C
Lubricants, in tubes, for Nordstrom valves, bulletin B-220	88-89
Lubricants, lubripaste	1401
Metallic phosphates	272B
Molasses stillage products	71-72b
Molding compound	263D
Naptha, fast-drying, MNA-53	391
Nonyl phenol	379
Oil, industrial, stanol	73
Oxo alcohols	129
Ozone	303a
Phosphates, ammonium & potassium	174-175f
Phosphates, solid aluminum acid, bonding agents	174-175g
Phosphoric acid	174-175b
Phosphorous chlorides	96-97
Phthalic anhydride	454
Plasticizers	174-175e
Polybutenes	48
Polyester	262A
Polyols, sorbitol	433
Polyvinyl acetate	270A
Propylene glycol	267
Reagents	365A
Reagents and fine chemicals	271
Resin	263E, 266A
Resin coating	264D
Resin dispersion	270B
Resins	
Coumarone	173
Ion exchange	317
Piccolyte	54
Printing ink	71-72c
Synthetic	117
Synthetic, cation exchanger	58
Rot and mildew preventive, milmer	174-175d
Safety, chemicals handling	364B
Seamless capsules	266B
Silicas, fine sized	335b
Silicofluorides, organic	335a
Silicone rubber	263A
Soda ash	364K
Sodium	365F, 366M
Sodium, high surface	71-72a, 323
Sodium phosphates	406
Sodium sulfate, anhydrous	113

## EQUIPMENT

Absorbers, HCl	295
Air and gas handling equipment	383
Air handling equipment	
Air conditioner	244E
Blowers	
Centrifugal	41
Centrifugal, high pressure	100-101b
Soot	366H
Duct systems, utility sets	75
Fans	455
Fans, axivane	397
Fans, cooling towers	435
Apparel, industrial, orlon	BR435
Barrel skids	365E
Belts	
Conveyor	168
V	365I
V, grommet	15
Bins, storage, industrial, glazed tile	T141
Boiler control	366G
Boilers, steam, gas and/or oil fired	161
Casters and wheels	396M
Castings	366D
Catalyst supports, alundum	178
Centrifuges	21, 98
Centrifugals, suspended, open top	B342
Chains	366J
Cladding machine, lead	250A
Classifiers, air	74e
Cleaner, hydraulic jet	255A, 255C
Closures, drum	25
Columns, glassed steel, bulletin 894-T-1	486
Combustion chambers, HCl	295
Combustion units, tandem, oil-gas	L404
Compressors	158
Air	248C
Axial	289e
Balanced/opposed, bulletin 118	251
Refrigeration, V/W	449
Rotary	289a

Computer	364R
Condenser tubes, "U-bend" in expendable pallets	329
Containers	
Bags	
Laminated-textile, waterproof	144
Multiwall	19, 86a, T384
Sharkraft	86c
Waterproof, paper-lined	86b
Drums, stainless steel	63
Sacks, multiwall	442
Control, pump sequence	246A
Conveying systems, bulk handling	345
Conveyors	
Belt	307, 364F
Bucket elevators	365K
Bulk, pneumatic, bulletin 529	123
Heavy duty roller	256A
Multi-tier	164
Retractable	256E
Screw	13
Screw, steam blanchers	L403c
Screw-type	362N
Coolers	
Cascade, impervious graphite	295f
Fluid, dry type	351
Watertube	B140
Coupling	
Gear	250D
Nylon gear	252A
Covers, filter element	R403
Disintegration equipment	
Bale breaker	29a
Disintegrators	L403a
Granulators	74d
Laboratory machines	347
Mills	
Ball	157e
Ball, continuous conical	157d
Grinding, bulletin 7121	83
Grinding, crushing & shredding	166
Hammer	74c
Roller	74b
Roller, bulletin 06B7218	103
Tube	46
Prebreakers	L403b
Pulverizers	74a
Shredders	29b
Dissolvers	29c
Drives	366P
Drives	
Gearmotor	43
Power, fluid	135
Power, gearmotors	485
Drums, magnetic, permanent	268
Dryers	245, 362G
Dryers	
Monotube, book 2413	51c
Multi-louvre, book 2409	51b
Roto-louvre, book 1911-B	51-a
Sprav	67
With activated aluminas	65
Drying systems	
Flash, catalog 54-A	280
Freeze	184
Dust collectors	248B, 365L
Dust collectors	
Centrifugal	B325, LB348
Centrifugal, bulletin 551	B352
Electronic, precipitor	393
Filter	127, 260, 377
Filter type	321, 388
Ejectors, steam jet	66
Engineering & construction, process equipment	350
Evactors, stream-jet	341
Evaporators	
Flat plate	12a
Long tube film type	12b
Multiple-effect	L396
Triple effect, forced circulation	392
Fabricators	
Fabricators	
Piping	424a
Process equipment	365D, 389, 412
Processing equipment	
Alloy, bulletin 893	315a
Lead bonded	28
Stainless steel and aluminum	R400
Reaction vessels	339
Steel and alloy plate	94
Tanks, storage	452
Wire mesh assemblies	B326
Fans	364A
Fastenings, stainless steel, catalog 53D	320
Feeders	
Chemical, solution, dry materials	417
Dry, scale	147
Vibratory	257A
Rotary, airlock	451
Fermenters, vat	243C
File, blueprint	254A
Fillers, powder, vacuum	R408
Filter aids, celite	265
Filter cloths	TL421
Filters	
Centrifugal	11
Horizontal plate	304
MEK dewaxing	L400a
Precoat	243A
Pressure	
Continuous	L400c
Valley, rotating leaf	L400b
Salt, continuous vacuum type	L400d
Stainless steel, porous	300
String discharge	70
Vertical	
Clarification & solids recovery	10b
For liquid clarification	10a
Water, automatic, self-cleaning	474
Fire extinguishers	
Dry chemical	152, T298
General line	344
Portable	266
Fittings & fasteners, stainless steel	T352
Fittings	
Corrosion resistant	187
Forged steel	57
Pipe	35, 327b
Stainless steel	108-109a
Welding	353a, 424b, 409-410a
Welding	
Alloy steel	176a
Corrosion-resistant	333
Seamless	402
Stainless	BL384
Flanges	409-410b
Flanges	
Alloy steel	176b
Forged steel	353b
Floodlight, vapor proof	250C
Furnaces	
Kettle	244A
With reradiating cone	121
Gaskets	
Heat exchanger	470
Spiral-wound	278
Gas movers	
Blowers, multi-stage	289c
Blowers, single stage	289b
Gear turbines, close-coupled, type E	
Book B-4346	53
Generators	
Atmosphere	
Inert, bulletin 1-552	L408b
Nitrogen, bulletin 1-552	L408a
Inert gas, bulletin 1-10	434
Steam	244F
Heat exchangers	
Continuous flow, catalog No. 12	185
Shell & tube	295a
Tube	B314
Tubular	55
Heat transfer equipment, plate coils	
bulletin P 61	259
Heaters, flat radiant	244C
Hose & tubing, flexible metal	177
Hose, flexible metal	60
Instruments	
362F, 362U, 364C, 364L, 364S, 364U, 366I, 366N, 366T	
Instruments	
Analysis cells	146b
Analyzers, infrared process	258A
Analyzers, plant stream	124
Annunciator systems	316
Computers, analog, bulletin B4	125
Control, pressure, bulletin 5P	TR435
Control and detection, temperature	30
Control systems	
Evaporator	102
Plug-in type	357
Tube expansion	252
Controllers, temperature, self-operating	136
Cycling control valve	259A
Electronic control	362H
Electronic recorders	362K
Electronic transmission	362I
Elements, flow sensing	305
Flow meters, ring balance	49
Gages	
Chemical	286
Density	R416
Liquid level, non-frosting	366
Tank	T326
Gas analysis apparatus	261D
Geiger counters	366Q
Indicators	
Console	443
Temperature	T385
Manual controls	362J
Measurement and control	
Composite catalog 5000	418-419
Flow	84
Fluid flow	362B
Measurement, air velocities, bulletin 2448-G	1437
Meters	
Liquid	B328
Pressure	260A
Motor control centers, GEA-4979A	78
Photometers, flame, data file 20	L438
Potentiometers	
Gage pressure	L416
Indicator, portable	261E
Recorders	366F
Resistance thermometer	362L
Saybolt chromometer	261A
Signal relay unit	261B
Spectrometer, analytical mass	429
Speed changer, miniature	261C
Thermistors	146a, T297
Thermometers, all-metal	151
Timers	366E
Transmitter	362M
Transmitters, differential, pneumatic	
Data book 1002	319
Viscometers, synchro-lectric	BR348
Insulation	364Q

Insulation	
Cement, plastic	324
Magnesia, high temperature	68
Rock wool, rigid block	270
Jets, steam	295e
Joints	
Ballbearing, swivel	441
Flexible	80
Rotary pressure	244B
Junctions box	
Explosion proof	255D
Vapor tight	255B
Kettles	
Agitator, stainless steel, steam jacketed	B310
Stainless clad	288a
Laboratory ware, platinum	26
Lamp, mercury vapor gage	244D
Light, moving beam warning	250F
Lighting fixtures, explosion-proof	34
Liner, drum	256D
Lining	
Brick	295d
Porcelain, brick	R438
Protective, hard rubber	56
Tank, saran rubber	R411
Magnets, non-electric, permanent	337a
Materials handling equipment	366C
Materials handling systems	179
Materials of construction	
Alloys, hard facing	376
Alloy, hastelloy alloy	291
Copper and copper alloys	373
Hard rubber, tempron	247b
Insulating, foampglas	61
Metals, precious	
Gold	254b
Platinum	254a
Silver	254c
Nickel alloys, for pump shafts	426
Plastics, industrial	285
Polyvinyl chloride, unplasticized, rigid	299
Stainless steel	398, 432
Steel	188
Teflon	R421
Weld metals	364M
Mist eliminators, knitted wire mesh	M401
Mixers	365C
Mixing equipment	
Agitators	126
Agitators, turbine	157g
Blenders, dry	157f
Mills, general line, bulletin AH-440-11	365
Mixers	
Banburg, bulletin 189	62
Chemical	367
Double-arm	272
Eppenbach, "Agi", circular 403	T346
Laboratory, catalog DH-50	241a
Portable	157a
Portable, electric, and air driven catalog B-75	241b
Ribbon	157c
Side entering	157b
Side entering, catalog B-104	241e
Top entering, turbine & paddle types, catalog B-102	241c
Top entering, propeller type, catalog B-103	241d
Muller, mix-muller	427
Propellers	BR384
Motor controls	362S

Motors	
Air, form 5072	439
Electric	
Chemical, bulletin B-2201	287
Chemical, pre-lubricated	430-431
Indoor and outdoor	27
Industrial	334
Protected	415
High slip	252B
Outdoor splash proof	100-1012
Synchronous, low and high speed	180-181
Nozzles, spray	T328, R404
O-rings	365-R
Ozonators	303b
Packaging equipment	
Bag closing machines	R437
Interior packaging material	182
Liners	
Bag and drum, polyethylene	86d
Drum, polyethylene	T314
Packings	
Braided teflon	336
Pump, teflon, 711 series	257b
Stuffing box, teflon, 620 series	257c
Valve, teflon	257a
Painting equipment, spray	364H
Pelletier, continuous	360, 361
Pillow blocks, all steel	22
Pipe and fittings, hard rubber, tempron, bulletin 96-A	247a
Pipe and pipe fittings	B298
Pipe and tubing	
Stainless	R396
Stainless steel	108-109c
Pipe	362P
Pipe	
Fittings and valves	295c
Glass, Pyrex	354-355
Industrial vent, transite	313
Plastic	366K
Plastic, rigid polyvinyl	17
Saran rubber lined	362a
Stainless, schedule 5	172
Steel, saran lined	362b
Wood lined	362G
Pipelines	365G
Piping, shop fabricated	8
Power systems, installation	364N
Precipitators, electrostatic	44
Preheater, air, ljunstrom	50
Presses, filter	T312
Process equipment	3650
Process equipment, commercial metal and alloy	394
Processing equipment, alloy	315b
Pulleys, magnetic	337b
Pumps	364I, 366A, 366S
Pumps	
Acid	414
Centrifugal	295b, 453
Centrifugal	
Catalog ET-452	153
Corrosion-resistant	108-109b
Self-priming	24
Single stage, double suction, bulletin No. 721.6	378
Standardized end suction	76-77
Chemical	
General purpose	145
Rubber lined, bulletin WQ-212	368
Controlled volume, auto-pneumatic	261
Dry vacuum	289d
Heavy duty, series R, bulletin P/1	293
Horizontal, chemical	186
Installation data, bulletin TS-3C	.T342
Liquor, type CL	59
Metering and proportioning	
type U	160
Portable	366R
Positive	248A
Rotary	362D
Sanitary, positive displacement	B346
Screw, bracket type, bulletin SE-5	159
Solids and acid handling	362A
Submerged centrifugal	365M
Vacuum, catalog 700	331
Vacuum, oil sealed, mechanical, bulletin V-51B	407
Vertical	
Chemical, bulletin V-837	364
For abrasive, corrosive slurries bulletin, 203-6	386
Purifiers	3660
Receptacles and plugs, heavy duty, waterproof	B297
Rectifiers, mechanical	170-171
Refractories, brick, fused-alumina	165
Roasters, multiple-hearth, skinner	BL421
Roll, belt return	256F
Safety equipment	
Respiratory protection	3640
Respirators, twin cartridge	14
Scoops	
Lift truck	257C
Power, automatic	420
Screen, vibrating	243B
Seal storage bunker	256C
Seals, shaft, mechanical	139, B141
Separators	
Non-electric, drum type	337c
Specific gravity, lab-size	M437
Siding, industrial, aluminum	471
Sifters	74f
Skids, magnesium barrel	257B
Speed reducers, worm gear	111, 311
Starters, motor, high voltage, bulletin GEA-5409A	473
Switch	
Heavy duty	254B
Heavy duty safety	250B
Switchgear	
Low-voltage, booklet B-5282	371
With transfer bus	81
Tank cars	364J
Tanks	
Haveg, bulletin F-6	131
Storage	387, T456
Storage, concrete	L411
Tape, drafting symbols	250E
Tantalum	162
Temperature control	366L
Towers	
Condenser, for condensing refrigerants	38
Cooling	9
Cooling	
Catalog, CT-52-4	42
Counterflo	413
Mechanical draft	472
Impervious graphite	295g
Tractors	
Shovel	87, 90
Towing	284c
Trailers, tank	23
Transformers,	
Power	375
Variable	359
Traps	
Steam, bulletin 152	.B312

Impulse	163
Steam, thermostatic, balanced	
pressure	39
Tray, distillation tower	242A
Trucks	
Fork	284a
Hand	257D
Hand, powerized	284b
Lift and fork	256B
Tube cleaner, pistol grip, bulletin	
1046	150
Tubes	
Condenser and heat exchanger, copper base alloys	450
Flow, bulletin FT-101	382
Heat exchanger, carbon and stainless	
less	301
Tubing	362T
Tubing	
Copper	79
Copper, water	144
Flexible plastic, tygon	104
Stainless and high alloy	330
Steam	69
Unloaders, car	BR385
Valves	362E, 365B
Valves	
Bronze	33, 327a, 436a

Check, tilting disc	52
Control	64
Control	
Diaphragm, double seated	440
Diaphragm, expanded outlet	82
Corrosion-resistant	18, 183, 436d
Cylindrical plug	137
Diaphragm	
Motor-operated, catalog FL382A	16
Packless	279
Electric, high pressure	95
Gate, steel	395
General line	45
Globe, angle check	3620
Iron	436b
Porcelain	405
Pressure reducing	
Bulletin 962	273
Water	130a
Proportional, wide band, bulletin	
700-2	20
Regulator, bulletin 100	349
Safety-relief	31
Steel	436c
Surge relief, bulletin W-2	130b
Vaporizers, dowtherm	340
Vessels	
Lined, corrosion-resistant	306
Pressure	155
Processing	288b
Water treatment	364G, 365P
Water treatment	
Accelerators, bulletin 1825-X	255
Deminerlizers	365Q
Ion exchange	365N
Well water systems	133
Wire cloth parts	358
Wire cloth rolls and fabricated units	T310

## SERVICES

Computing service	LB385
Consultants	365J
Engineering and construction	
Nitric acid plants	92
Petroleum refineries	37
Plants	119
Plant processes	363
Plants, processes & apparatus	2
Sulfuric acid plants	428
Engineering, design & fabrication, process equipment	47
Maintenance cleaning, with chemicals	249
Prototype development, equipment	253
Terminals, bulk liquid storage	283

## Use This Handy Postcard to Help You in Keeping Up-to-Date

Circle numbers of desired items, fill in reverse side, tear out and mail

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(Card expires July 1)

. . . Items in this Reader Service section as circled below:

2	33	64	87	130a	167d	178	245B	257a	268	289b	B310	335a	357	364A	365H	366B	395	L611	436b
6-7	34	65	88-89	150b	157e	179	248C	257d	266	289c	311	335b	358	364B	365I	366T	L396	R411	436e
8	35	66	90	131	157f	180-181	249	257e	266a	289d	T312	335e	359	364C	365J	366U	M1396	412	436d
9	37	67	92	132	157g	182	250A	257A	266b	289e	B312	335f	360	364D	365K	367	R396	413	436f
10a	38	68	93	133	158	183	250B	257B	267	291	313	337a	361	364E	365L	368	397	414	436g
10b	39	69	94	134	159	184	250C	257C	268	293	T314	337b	362a	364F	365M	369	398	415	436f
11	41	70	95	135	160	185	250D	257D	268a	295a	B314	337c	362b	364G	365N	371	399	L416	436h
12a	42	71-72a	96-97	136	161	186	250E	258A	269	295b	315a	338	362a	364H	365O	375	L400a	R416	436h
12b	43	71-72b	98	137	162	187	250F	259	270	295c	315b	339	362B	364I	365P	375	L400b	417	436i
13	44	71-72c	99	139	163	188	251	259A	270A	296d	313	340	362C	364J	365Q	378	L400c	418-419	440
14	45	73	100-101a	T140	164	241a	252	260	270B	296e	317	341	362D	364K	365R	377	L400d	420	441
15	46	74b	100-101b	B140	165	241b	252A	260a	271	296f	318	T342	362E	364L	366	378	R400	TL421	442
16	47	74b	102	T141	166	241c	252B	261	272	296g	319	B342	362F	364M	366A	379	L401	BL421	443
17	48	74c	103	B141	167	241d	253	261A	272A	296h	320	343	362G	364N	366B	381	M401	R421	444
18	49	74d	104	143	168	241e	254a	261B	272B	298	331	344	362H	364O	366C	382	R401	428	445
19	50	74e	107	143	169	242A	254b	261C	272C	298	332	345	362I	364P	366D	383	403	424a	449
20	51a	74f	108-109a	144	170-171	243A	254e	261D	278	T397	324	T346	362J	364Q	366E	T384	L403a	424b	450
21	51b	75	108-109b	145	172	243B	254A	261E	278	B297	T325	B346	362K	364R	366F	BL384	L403b	425	451
22	51c	76-77	109-109c	146a	173	243C	254B	262A	279	T298	B325	347	362L	364S	366G	BR384	L403c	426	452
23	52	78	111	146b	174-175a	244A	255	262B	280	B298	T326	T348	362M	364T	366H	T385	R403	427	453
24	53	79	113	147	174-	245B	254a	262C	283	299	B326	BL348	362N	364U	366I	BL385	L404	428	454
25	54	80	117	150	174-	245c	255B	263A	284a	300	327a	BR348	362O	364V	366J	BR385	R404	429	455
26	55	81	119	151	174-175d	244D	256C	263B	284b	301	327b	349	362P	365	366K	386	405	430-431	T485
27	56	82	121	152	174-	244E	256D	263C	284c	305	T328	350	362Q	365A	366L	387	406	432	470
28	57	83	123	153	174-	244F	256E	263D	285	303b	B328	351	362R	365B	366M	388	407	433	471
29a	58	84	124	154	174-	245c	256B	263E	286	304	329	T352	362S	365C	366N	389	L408a	434	472
29b	59	85	125	155	174-	245b	256C	264A	287	305	330	B352	362T	365D	366O	391	L408b	L435	473
29c	60	86a	126	156a	175a	247a	256D	264B	288a	306	331	353a	362U	365E	366P	392	R408	TR485	474
30	61	86b	127	157b	175b	247b	256E	264C	288b	307	333	353b	363	365F	366Q	393	409-410a	BR485	485
31	62	86c	129	157c	177	248A	256F	264D	289a	T310	334	354-355	364	365G	366R	394	409-410b	436a	488
32	63	86d																	

. . . Items in the Reader Service "Flashback" Section (p. 482)

240A	242D	246B	248E	254C	256E	260A	262A	266B	372B	372I	372P	374E	374L	374S	375E	375L	375B	376E	378L
240B	244A	246C	250A	264D	256F	260B	262B	268A	372C	372J	372Q	374F	374M	374T	375F	375M	375T	376F	378M
241A	244B	246D	260B	268A	266G	260C	262C	270A	372D	372K	372R	374G	374N	374U	375G	375N	375U	376G	378N
241B	244C	246E	252A	265B	257A	260D	262D	270B	372E	372L	372S	374H	374O	374W	375H	375M	375W	376H	378O
241C	244D	248A	252B	266A	258A	261A	262E	270C	372F	372M	372T	374I	374P	374X	375I	375Q	375T	376I	378P
242A	244E	248B	263A	265B	258B	261B	264A	270D	372G	372N	372U	374J	374Q	374Y	375J	375S	375U	376J	378Q
242B	244F	248C	264A	266C	259A	261C	266A	272A	372H	372O	372V	374K	374R	374Z	375K	375T	375V	376K	378R
242C	246A	248D	264B	266D	260B	261D													

. . . Send me these reprints, I will remit on receipt. (See last Reader Service Page for descriptions.)

1 2 3 6 9 10 11 13 14 15 17 18 19 20 21 22 22a 22b 23 24 25 26 27 28 29 30

# Flashback . . .

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The listings on this and the following page is a repeat of the editorial listings only on chemicals, equipment and services featured last month in the New Equipment, New Products and New Technical Literature departments. Use the postcard below for more information on any item in this list.

## CHEMICALS

Acetone	375K
Brake fluids	375O
Caustic soda	376N
Chemicals	374F, 374M, 376A, 376R
Chemicals from coal and petroleum	372E
Chloroacetaldehyde	375N
Coatings, protective	375A, 375D
Demineralized water	375T
Descaler	262A
Dibutyl phthalate	375H
Disinfectant, for water	264A
Fatty acids	372F, 372D
Fatty acid ketones	266B
Formic acid	372I
Fortifier, for rubber	261C
Fungicide	375J

Furfurylamine	268A
Herbicide	260B, 262B
Methanol	372C
Methyl amyl alcohol	375R
Methyl glucoside	260A
Molybdenum disulphide	270D
Nylon, powdered	372L
Paints, rubber based	262E
Plasticizer	261B
Plastics	375G
Plastisol	270B
Polyvinyl chloride, sheet	270C
Potassium titanium fluoride	262D
Primer, for vinyl	262C
Resins	260C, 376K
Sodium Hydride	374N
Solvents	261A, 266A
Sorbitol	375U

Stabilizer, for polyvinyl chloride resins	374S
Styrene oxide	375M
Sulphur hexafluoride	372N
Surfacing material	261D
Tetracarboxybutane	260D
Water repellent, silicone base	376L
Wax, synthetic	270A

## EQUIPMENT

Amplifiers	375S
Belts	
Conveyor	256F
V.	376F
Burner, oil	246C
Calendar	374K
Cleaner, heavy duty steam	246D
Clutches	376M
Controls, process	374G
Conveying system	256B
Conveyors	374A
Conveyors	
Belt	372G, 372H
Cranes	374C
Drums, rubber	372J
Dust collector	372B
Ejectors	372P
Elevator, bucket	256G
Equipment, wooden	376E, 376F
Extractor, solvent	372A
Fabricators	
Metals	376I
Fans	372R
Feed system, liquid chemical	242C

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Chemicals, Equipment, Services, Reprints. Directions on the other side.

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Filter media	3720	Viscosimeter, multi-station	248E
Filters		Warning system, static	254A
Downflow tray	241B	Insulation	
Fittings		Thermal	372M
Pipe, plastic	244E	Joints	
Gasketing	374E	Steam, rotating	246B
Heat exchangers	246E	Swing	376D
Heaters	374P, 376H	Kettles	
Gas immersion	246A	Portable resin	240B
Wire screen cloth	241C	Materials handling	372Q, 375B
High vacuum equipment	376Q	Mixing equipment	
Impulse rendering of fats	372K	Agitator, horizontal flow	244F
Instruments	374J, 374L, 374 T, 376C	Mixers	
Analyzers		Pulp bleaching	240A
Gas, infrared	248A	Motors	
Oxygen	248B	Safety	376P
Controllers		Nozzles	
Atmospheres	250B	Venturi flow	242D
Detector, static	248C	Nylon parts	374U
Measurement transducers	375I	Packaging equipment	
Monitor, liquid color	252A	Filler, bag	257A
Pneumatic chart drive	248D	Pallet, steel	258A
Positioner, pneumatic	250A	Plant models	376O
Precision bared tubes	375Q	Power transmission	375L
Recorders		Pumps	374D, 374O, 375F
Electronic	252B	Ramp, magnesium	259A
Transducer, pressure	253A	Reel, fire hose	254D
Viscometers	375E	Rolls	
		Belt idler	256A

Safety equipment	
Hat, fiberglass safety	254C
Shower, trailer mounted	255B
Scales	
Electronic crane	258B
Speed reducer	374Q
Strainer	374H
Strainers	
Pipeline, self-cleaning	242A
Tool handles, non-slip	254B
Towers	
Glass, acid absorption	241A
Traps	
Steam	376G
Trucks	
Lift, heavy duty	256D
Plant fire	255A
Tubing	
Seamless, stainless	244D
Unloader, truck trailer	256E
Vacuum	374B
Valves	
Hydraulic relief	242B
Plug, porcelain	244A
Solenoid	244B
Venturi	244C

## SERVICES

Transition manufacturing ..... 376B

## Two Postcards—One for you, one to pass along

Circle numbers of desired items, fill in reverse side, tear out and mail

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(Card expires July 1)

. . . Items in this Reader Service section as circled below:

2	33	64	87	130a	157d	178	248B	257a	265	289b	B310	335a	357	364A	365H	366B	366	L411	436B	
6-7	34	65	88-89	130b	157e	179	248C	257b	266	289c	B311	335b	358	364B	365I	366T	L306	R411	436e	
8	35	66	90	131	157f	180-181	240	257e	266A	289d	B312	335e	360	364C	365J	366U	M306	412	436d	
9	37	67	92	132	157g	182	250A	257A	266B	289e	B312	336	361	364D	365K	367	H307	413	437	
10a	38	68	93	133	158	183	250B	257B	267	291	B313	337a	362	364E	365L	368	397	414	M437	
10b	39	69	94	134	159	184	250C	257C	268	293	B314	337b	362a	364F	365M	369	398	415	437	
11	41	70	95	135	160	185	250D	257D	268A	295a	B314	337c	362b	364G	365N	371	399	L418	L438	
12a	42	71-72b	96-97	136	161	186	250E	258A	269	295b	B315a	338	362a	364H	365O	373	L400a	R418	R438	
12b	43	71-72b	98	137	162	187	250F	259	270	295c	B315b	339	362B	364I	365P	375	L400b	417	439	
13	44	71-72e	99	139	163	188	251	259A	270A	295d	B316	340	363C	364J	365Q	376	L400c	418-419	440	
14	45	73	100-101a	T140	164	241a	252	260	270b	295e	B317	341	363D	364K	365R	377	L400d	420	441	
15	46	74a	100-101b	B140	165	241b	252A	260A	271	295f	B318	342	363E	364L	365S	378	H400	TZ421	442	
16	47	74b	102	T141	166	241c	252B	261	272	295g	B319	342a	362F	364M	366A	379	L401	BL421	443	
17	48	74c	103	B141	167	241d	253	261a	273	295h	B320	343	362G	364N	366B	381	M401	R421	444	
18	49	74d	104	142	168	241e	254a	261B	273b	295i	B321	344	362H	364O	366C	383	H401	428	445	
19	50	74e	107	143	169	242A	254b	261C	273c	296	B322	345	363I	364P	366D	383	429	434a	446	
20	51a	74f	108-109a	144	170-171	243A	254d	261D	273	297	B323	346	363J	364Q	366E	384	T384	L424b	450	
21	51b	75	108-109b	145	172	243B	254A	261E	278	297	B324	346a	362K	364R	366F	385	BL384	L424b	451	
22	51c	76-77	109-109b	146a	173	243C	254B	262A	279	T398	B325	347	362L	364S	366G	386C	BR384	L426	452	
23	52	78	111	146b	174-175a	244A	255	262B	280	B326	T326	348	362M	364T	366H	387	T385	R403	453	
24	53	79	112	147	174-175b	244B	255A	262C	283	299	B326	348	362N	364U	366I	388	BL385	L404	454	
25	54	80	117	150	174-175e	244C	256B	263A	284a	300	B327a	349	363O	364V	366J	389	BR385	R404	455	
26	55	81	119	151	174-175d	244D	256C	263B	284b	301	B327b	349	362P	364W	366K	389	405	430-431	T456	
27	56	82	121	152	174-175e	244E	256D	263C	284c	302a	B328	350	362Q	365A	366L	387	406	432	470	
28	57	83	123	153	174-175f	244F	256A	263D	285	302b	B328	351	362R	365B	366M	388	407	433	471	
29a	58	84	124	154	174-175g	245	256B	263E	286	303	B329	352	362S	365C	366N	389	L405a	434	472	
29b	59	85	125	155	174-175h	245A	256C	263F	287	305	B329	353	362T	365D	366O	391	L405b	L435	473	
29c	60	86a	126	157a	175a	247a	256D	264B	288a	305	B330	353a	362U	366E	366P	393	R406	TR435	474	
30	61	86b	127	157b	175b	247b	256E	264C	288b	307	B330	353b	362V	365F	366Q	393	409-410a	BR435	455	
31	62	86c	129	157c	177	248A	256F	264D	289a	T310	354	354-355	364	362W	365R	366S	394	409-410b	436a	456
32	63	86d																		

. . . Items in the Reader Service "Flashback" Section (p. 482)

240A	242D	246B	248E	254C	256E	260A	262A	266B	272B	272I	272P	274E	274L	274B	275H	275L	275B	276E	276L
240B	244A	246C	250A	254D	256F	260B	262B	268A	272C	272J	272Q	274F	274M	274T	275F	275M	275T	276F	276M
241A	244B	246D	250B	256A	256G	260C	262C	270A	272D	272K	272R	274G	274N	274U	275G	275N	275U	276G	276N
241B	244C	246E	252A	258B	257A	260D	262D	270B	272E	272L	272S	274A	274O	274W	275A	275H	275S	276A	276H
241C	244D	246F	252B	258A	257A	260E	262E	270C	272F	272M	272T	274B	274P	274X	275B	275J	275T	276B	276O
242A	244E	248B	253A	256B	258B	261A	262E	270C	272F	272N	272V	274C	274Q	274Y	275C	275J	275V	276C	276Q
242B	244F	248C	254A	256C	259A	261C	262A	272A	272R	272O	272W	274D	274R	274Z	275D	275K	275W	276D	276R
242C	245A	246D	264B	266D	269B	261D	262D	272D	272S	272P	272X	274E	274T	274Z	275E	275L	275X	276E	276T

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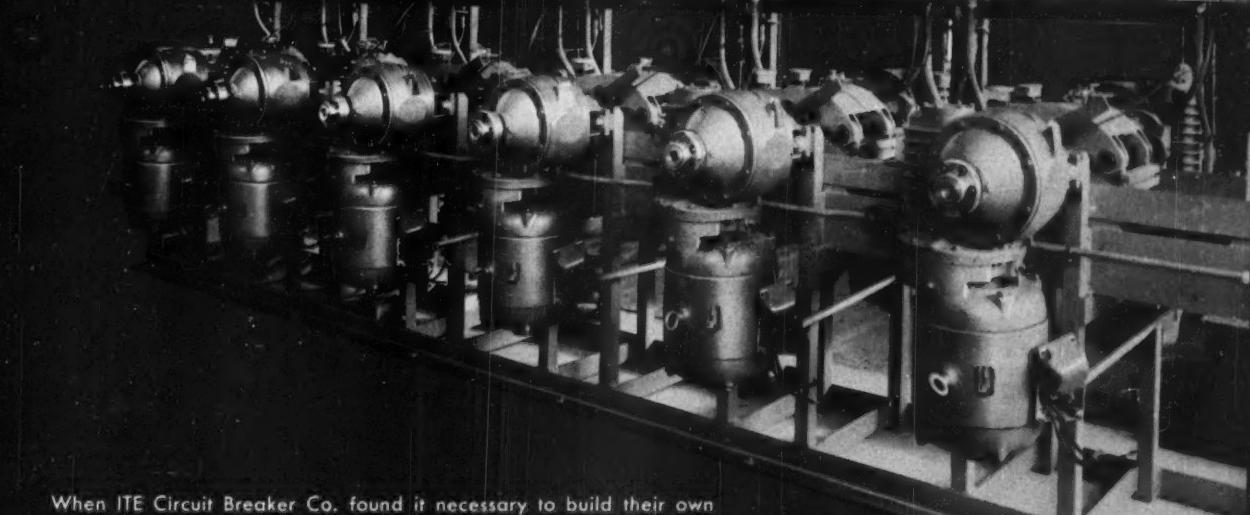
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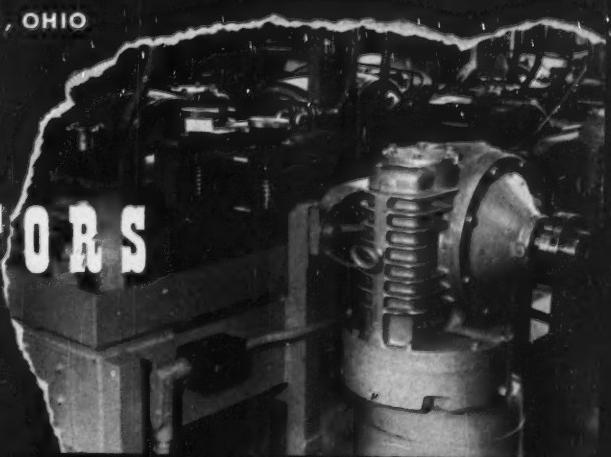
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